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THE ROCKEFELLER FOUNDATION

THE reviews of the work of the Rockefeller Foundation which we are accustomed to receive from its President are far more than mere summaries of the activities of the Foundation during the year under review. They represent an intellectual stock-taking—an assessment of the position of the creative forces of civilization, its moral and spiritual, as well as scientific, resources, and an attempt to appraise the directions in which special efforts are required. Dr. Fosdick's review of 1947 is no exception, and with insight and courage delineates the challenge which Western society faces to-day and the points at which special efforts are necessary to avert pressing danger.

Dr. Fosdick starts his review with a glance at the appropriations of the Foundation during 1947. Amounting to 23,413,615 dollars, or nearly four million dollars more than those in 1946, they represent the largest annual appropriation in the history of the Foundation. They include a single grant of ten million dollars to the China Medical Board for the support of the Peiping Union Medical College, another 2,225,000 dollars for public health, and 1,500,000 for medical sciences, 1,700,000 for natural science, 3,000,000 for social sciences and 1,500,000 dollars each for the humanities and for the General Education Board. Of this total 39 per cent was for work in the United States and 61 per cent for work in other countries.

The central issue to which Dr. Fosdick directs attention in this report is that of the misuse of knowledge, and while he recognizes that in the present situation an element of physical force is essential he insists that that alone will be of no avail unless we meet the challenge on an intellectual and ethical plane. Here the emphasis on the task of raising the material standards of living can be an obstacle. A solid material foundation may be an essential basis for a high civilization; but Dr. Fosdick points out that it is a basis and not a superstructure. So, too, our reverence for the physical sciences and acceptance of the doctrine that civilization can be bred to greatness and splendour by science hinders our responding to the challenge at a higher level. The gap between the physical sciences and the humanities and social studies, in terms of endowment, research facilities and teaching staffs, needs to be closed, whereas in fact it is growing wider.

Dr. Fosdick recognizes the debt which mankind owes to science in giving us the methods and patterns of research in human relationships; but he insists that to the problem of discovering a new set of human purposes, to the art of human relations, to the winning of wisdom, physics, chemistry and engineering contribute little. They are ethically neutral, and the issues of our time and of human destiny will be determined not at the physical but at the ethical and social levels. If this age is to achieve greatness it will not be through its physical triumphs, but through the discovery of an enlightened humanism and of new spiritual and moral values that lead men forward.

The immediate task, in Dr. Fosdick's view, is to discover the common interests, the areas in which collaboration is possible, where curiosity and sympathy, aspiration and mutual advantage overlap. The search for these rallying points, the development of new techniques and areas of co-operation where ideas and experience can be pooled and combined, lays the foundation of the ultimate structure of a unity never yet achieved in the world. In this connexion it should be noted that while representatives of the Rockefeller Foundation visited practically every country in the world in 1947, visas to enter Bulgaria and the Soviet Union could not be obtained and no contact could be established with their scholars and scientists. And in all the countries which representatives of the Foundation visited the passionate desire for peace, security and a better life formed the universal pattern of thinking and planning, whatever the differences of opinion as to the means by which these ends are to be achieved.

We have already noted in these columns Dr. Fosdick's comments on the unhappy effects of isolationism on science and the major responsibility which here rests on the Soviet Union. It is because medicine stands so clearly above political ideology that Dr. Fosdick justifies the large appropriation for the development of modern medicine in China at the present time, as he does the increasing support given in the field of public health. There also the widening horizons, the fading of the borderlines between curative and preventive medicine, are giving public health the stature of a social science in the service of society. Dr. Fosdick clearly looks upon the World Health Organisation of the United Nations as a real unifying force in the world and one vehicle through which our new knowledge and widening conceptions of public welfare may make health, if not infectious, at least within the reach of all men.

Another unifying factor, at least in the world of science, is what Dr. Fosdick describes as the cross-breeding of biology with physics as well as chemistry. Biophysics, in particular, with its demands for such expensive equipment as ultracentrifuges, X-ray equipment, spectrophotometers and cyclotrons, demands co-operation across national frontiers, and the Foundation made a number of large grants in this field in 1947, including 250,000 dollars to the Massachusetts Institute of Technology, 50,000 dollars to the California Institute of Technology, 85,000 dollars to Prof. W. T. Astbury at Leeds, and 21,000 dollars to Prof. J. T. Randall, director of the Biophysics Unit of King's College, London.

Of the grants in the field of social sciences and in the humanities, Dr. Fosdick observes that they are intended to assist a more adequate analysis and understanding of the issues in international relations, to widen the horizons of the political and economic life of men, to extend the frontiers of the mind in time as well as in space. The programme of research assisted from this point of view also has claims upon the interest of the physical as well as of the social scientist. One particular problem is of exceptional interest at the present moment and is a challenge to this country which is unmistakable.

During 1947 Dr. R. J. Havighurst, of the University of Chicago, made an extensive study for the Foundation of the situation in Germany as regards the universities, primary and secondary schools, libraries, youth problems and policies, teacher training, contacts with the outside world and so on. Dr. Fosdick summarizes very briefly the observations and recommendations of this report, stressing the poverty of Germany and the utter isolation which affects many men of goodwill in Germany, and asserting that nevertheless the foundations for a peaceful and productive democratic society are present in Germany to-day. Moreover, the two prerequisites to the development of such a democratic society—the restoration of communications between the Germans and the people of other countries, and the development of younger leaders who know the world outside of Germany—are steps no less needed in Austria and Italy, as well as in all the countries where people have been cut off from free and natural intercourse with the people of other countries.

In addition to its regular European programme, the Rockefeller Foundation in 1947 set aside 500,000 dollars for work in this field of European reconstruction. The examples of these appropriations cited by Dr. Fosdick indicate the challenge that the Foundation's work represents to Britain, which no less than the United States bears responsibility for administration in Germany. The sum of 120,000 dollars has been given to the University of Chicago to set up an American faculty in the University of Frankfurt. From six to ten university professors from Chicago, selected primarily from the field of the social sciences and the humanities, will be constantly in residence at Frankfurt for periods of at least six months. A grant of 60,000 dollars over three years to the Germanistic Society of America is for the supply of scholarly periodicals to fifteen German and three Austrian university libraries, and a grant of 25,000 dollars to Columbia University is intended to facilitate the establishment of German radio as a public service free from political control by bringing to Great Britain, the United States and Canada, leading German personnel from German radio stations to acquaint them with the rights and responsibilities of British, American and Canadian radio.

These are precedents which deserve to be marked and studied by the British Government and universities as well as men of science. As Mr. Kenneth Lindsay has urged, it is a time to increase and not to restrict, as has been done, for example, with book imports, cultural relations of all kinds, at least between those countries within the Marshall plan and the United States. To be fully effective, political and economic organs must be matched with the acceptance of common values which in general terms must permeate the schools and the universities. Moreover, the universities carry a large measure of responsibility for establishing a community of ideas and ideals.

An important factor to both these ends is the interchange of teachers and students. That interchange has been sadly interrupted during the past year by travel restrictions, direct and indirect, and

though the British Council is doing something in this field, as has been pointed out in *The Universities Quarterly*, its postgraduate courses for American and other overseas students at British universities are prohibitive in their cost for most students from European countries. Here it would seem is an opportunity for Government action to relax restrictions at least. Again, it may be asking too much of any one British university at the present moment to establish faculties in German universities on the scale which, through the Rockefeller Foundation, the University of Chicago has done at Frankfurt. But can nothing on these lines be done corporately by the combined universities? Rather we might ask, can this country afford not to do so? General Robertson has recently set up a Commission of eleven members, of which the Master of Balliol is the one British member, to examine the state of the universities and technical schools in the British zone in Germany. That Commission will function with essentially the same freedom as a Royal Commission in Britain and may be expected to address itself with wisdom and energy to the task of university reform. Its composition should dispel any fears that reforms will be recommended which break drastically with the past and the German idea of a university as a home of mature learning and research.

But if the German universities are to meet the demands which will be made upon them in the reconstruction period, if the younger teachers are to be enabled to take the part which they could usefully play in the government of academic life, if that isolation to which all observers bear witness is to be removed, interchanges on such lines must make a large contribution. Books and periodicals have their place; but the interchange of staff and of students is as important for the revival of learning and the development of the German universities to meet their new opportunities as it is for the presentation and interpretation of the constructive side of British policy and of the British way of life.

Significantly enough in the recent debate on Overseas Information Services that aspect of the question escaped notice, though it might well have been one compelling reason for the Government to relax some of the restrictions hampering such interchange if not for encouraging them by direct financial support.

Large as is the measure of responsibility resting upon the Government here the main driving force to action must come from the man of science and those nurtured with him in the universities who in those seats of learning have not only entered on the great heritage of Western civilization but have understood how great are the issues in the threat to liberty of thought, of investigation and of utterance in the modern world. In his passage dealing with the problem of Germany Dr. Fosdick crystallizes the essence of that challenge not only to Germany and Western Europe but also to the rest of the world, and he indicates some of the ways in which the man of science might work to overcome the lack of will and the lack of light by which, as John Masefield has warned us, one great land after another may be herded into a Dark Age in a very little time. The misuse and disuse of knowledge will only be averted as men of science answer that call, and, no longer content to enlarge the boundaries of knowledge in the laboratory, insist also on clearing the blocked channels of communication of knowledge and ideas, and seek to foster that cultural fellowship and intercourse in which the greatest and noblest elements in the heritage of the West find full and free expression.

REACTION KINETICS IN SOLUTION

The Kinetics of Reactions in Solution

By Dr. E. A. Moelwyn-Hughes. Second edition. Pp. viii+424. (Oxford: Clarendon Press; London: Oxford University Press, 1947.) 25*s*. net.

WHEN the first edition of this book appeared in 1933, it was not generally believed that reaction kinetics in solution could be profitably interpreted on a molecular basis, and there was relatively little planned experimental work of high accuracy. The author then attempted to show that a simple kinetic picture would account for a large number of the observed facts, and the success of this attempt provided an important stimulus for later theoretical and experimental work on reaction kinetics in solution. The amount of such work during the last fifteen years is very large, and the task of producing a second edition of the book must have been a formidable one.

In many respects the new edition reflects the great expansion which the subject has undergone: thus it contains 144 tables of numerical data, and references to original papers by more than a thousand authors. It is an admirable feature of the book that the data for many reactions are examined in detail, with a clear analysis of possible experimental errors and complications due to reversible, competing and consecutive reactions. The book thus provides a valuable and critical guide to a large range of experimental work, including related topics such as reactions taking place at a liquid–solid interface, reactions in surface films, and enzyme reactions.

On the theoretical side it is no longer necessary to wage a crusade for the application of molecular kinetics to reactions in solution, and the task is rather that of conducting a comprehensible tour through the many alternative formulations and refinements which have arisen since 1933. Dr. Moelwyn-Hughes has given pride of place to a particular type of development, namely, the elaboration of the simple collision theory by adding electrostatic terms for the mutual interactions of ions and dipoles, the solvent being regarded as a continuous medium. This procedure produces at least the appearance of a quantitative theory, and the present book derives and compares with experiment a large number of electrostatic expressions. Unfortunately, most of these expressions contain one or more adjustable parameters which have to be derived from the kinetic data, and all that can be demonstrated is that these parameters usually have a physically plausible value. In these circumstances many would prefer to adopt a superficially more qualitative treatment, which gives a picture of the part played by the individual molecules of solute and solvent and avoids the use of a macroscopic dielectric constant of doubtful significance.

It is remarkable that the terms 'transition state' and 'critical complex' do not occur in an index with more than 700 entries, and that the quasi-thermodynamic method is scarcely used at all in the book. It is true that the statistical equations of the transition state method are worked out in an appendix, but (as the author himself points out) they are of little service in predicting absolute reaction-rates in solution. The value of thermodynamic analogy does not lie in detailed calculation, but in the insight which it gives into the parallel effects of various factors (temperature, pressure, solvent, etc.) on reaction velocities and on equilibria. This aspect of the matter has not been clearly dealt with, and the chapter on "Equilibria" is concerned chiefly with the reverse process of explaining equilibrium constants in terms of kinetic considerations. At best, this procedure provides a derivation of familiar relations which is cumbrous and of limited validity, and at times it produces some curious results, for example (p. 196), an expression for an electrolytic dissociation constant which involves the viscosity of the solvent. This chapter might with advantage have been curtailed, or even omitted altogether.

It is possible to criticize a number of the author's detailed statements; for example, that an observed reaction order of two shows the slowest step to be bimolecular (p. 49), and that the slowness of esterification reactions in the gas phase must be due to a low collision factor (p. 242). However, in spite of this, and the more general criticisms indicated above, the author has given a useful survey of much recent material. If he has at times failed to give a clear picture of its significance, this is due, at least in part, to the great bulk of experimental work, and to the many and diverse interpretations which have been advanced.

R. P. Bell

PROPERTIES OF SLOW ELECTRONS IN GASES

Electrons in Gases

By Sir John Townsend. Pp. viii + 166. (London: Hutchinson's Scientific and Technical Publications, n.d.) 25*s*.

DISCHARGE phenomena, which may be as varied as lightning, the operation of counters, or the growth of photo-electric currents, all depend upon the mechanics of electrons in gases. Any picture of those processes which involve electron and atom collisions must be built upon experimental determinations of such factors as the atomic cross-section and the fractional loss of energy in collision. Further, the related entities of electron-drift speed and energy of agitation, or temperature, and probably the process of attachment also, depend upon those factors through the electron-energy distribution function. This function depends upon the electric intensity, the gas concentration, and on the variation of atomic cross-section with velocity, and thus varies from gas to gas in a manner which, for any given case, is at present best found experimentally.

For this reason the subject-matter of "Electrons in Gases" is of fundamental significance. The experimental work described is mainly that carried out by Sir John Townsend and his collaborators in Oxford since the publication of his treatise "Electricity in Gases"; and the present book, which is a research monograph, makes an interesting sequel. The description of the determinations of the mean electron energies and the atomic cross-sections for slow electrons by the diffusion method is very useful, as this technique has proved to be powerful and of wide appl cation. In the higher energy range the results are fundamental in discharge physics; but recent work on the interaction of radio waves in the ionosphere shows that the technique is also capable of giving important data in this field, where the electron energies are comparatively low and do not greatly exceed thermal values.

The book is confined mainly to giving the theory of the experimental methods and the results obtained: space does not permit full discussion of theoretical derivations of energy-distribution functions when considerable excitation and ionization occur. Except for a treatment of the electric spark at low pressures, other discharge phenomena lie outside the scope of the book: such applications have been treated in Townsend's earlier treatise and in later books on the subject by others. On the other hand, valuable data on the ionization coefficients in pure monatomic gases are given, and the book, which unfortunately lacks an index, can be strongly recommended to those engaged in research in this field.

F. Llewellyn Jones

PARTHENOGENETIC PATERNITY IN CENTRAL AUSTRALIA

Aranda Traditions

By T. G. H. Strehlow. Pp. xxii + 181 + 10 plates. (Melbourne: Melbourne University Press, 1947.) 17*s*. 6*d*. net.

IN the early days of the discovery of Australia by the whites, the aboriginals, or black fellows, were stigmatized as degenerate, treacherous and quite untamable. More sympathetic study of these people has, however, rather changed this uncompromising attitude, and once the language difficulty is overcome a far juster estimate of their character can be made. The author of this book was brought up in close contact with the Aranda, able not only to speak their language, but even to think in it. He is able, therefore, to describe their ceremonies and transcribe their chants and folk-tales accurately and feelingly, combining the point of view of the participant with that of the observer. Some previous students of the Aranda have not realized the extent to which the northern, western and southern divisions varied from each other, so that little generalization can be made as to customs and ceremonies as a whole. But by limiting the study to one area (in the first section of the book the northern Aranda area in Central Australia) the author is able to give a reasonably full account of the myths and religion of a strongly patriliniar group.

These myths are mostly brief accounts of the lives of totemic ancestors handed down by word of mouth by the old men to young initiates, usually on the occasion of a visit to the local spot where the *tjurunga* or sacred sticks and stones are hidden. By the power of their superior knowledge, the old men hold absolute authority in all matters of religion and custom, and there is no outlet for any creative impulse in the younger generation. Every possible site in the territory has already been assigned its own spirit or myth, and there is nothing left to the

young men but to follow the traditions of their elders—a stultifying state of affairs.

Mr. Strehlow gives a detailed account of the visit of initiates to one of these sacred caves, an account which recaptures the spirit of the occasion, and he follows this with a number of northern Aranda myths. It is interesting to see various threads running through them all, or at least through the majority. For example, the manner of origin of men from their totemic ancestor, in these cases so 'patrilinial' as to dispense altogether with any female intermediary, the sons being 'born' from the armpits of the father, as if the original inventors of the myth were unwilling to admit any possible claim on the part of women. Another point which is brought out is the hostility between the original father and his sons, leading to gross cruelty and frequently even to cannibalism.

The second part of the book deals with the three Aranda sub-groups already mentioned, distinguishing the customs of each group, especially those connected with *tjurunga* and initiation ceremonies.

The third part is concerned with *tjuru)ga* ownership, quarrels about which were frequent during the performances of the sacred ceremonies. The term *tjuru)ga*, as differentiated from *tjurunga*, is very indefinite and covers at least eleven different items, objects of stone or wood, sacred ground paintings or even sacred chants. In this section the author gives concise accounts of initiation festivals and also details of the laws governing *tjuru)ga* ownership.

The photographs illustrating the book are rather small and not very clear, but nevertheless give a good impression of the scenes they portray. The book itself is a valuable addition to our rather exiguous knowledge of this interesting and diminishing race.

K. Rishbeth

ALTERNATING-CURRENT POWER TRANSMISSION

Le grandi linee di trasmissione d'energia

Calcolazione elettrica. Per A. Dalla Verde. Pp. xi + 386. (Milano: Cesare Tamburini, 1947.) 1700 lire.

At present, the all-important problems of power transmission are those relating to long-distance energy transport and interconnexion of high-power networks. Examples of the first class are transmission from Norway to the Continent of Europe or to Great Britain, from the Victoria Falls to the industrial areas of South Africa, from Tasmania to Australia, from the Lower Danube to Central Germany. In the second class the realization of a European Grid system is the most imminent.

Quantitatively, these problems resolve into the transmission of total powers of the order of 1,000 to 3,000 MW. over distances of 600 km. and upwards. Transmission by alternating current at high voltage is the method which has been most fully developed. This system has become commonplace at voltages up to 220 kV. The maximum voltage at which extensive practical experience is available is 287 kV.—the voltage used for transmitting power from the Boulder Dam to Los Angeles. Sweden is constructing a 380 kV. power line more than 600 km. long, and a 220 kV. line in France has been designed with the view of facilitating its conversion to 400 kV. in the future. In progressing from 287 kV. to 400 kV., detail problems relating to the conductors and insulators have to be examined, such as corona losses, and transient voltages arising from switching or from natural causes.

Costs of transmission lines and apparatus rise so rapidly with voltage that every component has to be examined with the view of attaining maximum overall economy. The costs of the transmission lines themselves are so great that there is also incentive to study alternatives to the established three-phase, 50-cycle systems, such as D.C. transmission.

These generalities should make it evident that new authoritative work on electrical transmission is worth serious examination.

The appearance of an Italian treatise is specially opportune as Italy has done much individualistic pioneer work in electrical transmission at very high voltages, in conditions which demand the closest attention to economy. The volume under review deals with alternating-current transmission in seven main sections: fundamental line constants, electrical calculations of line characteristics, vector and circle diagrams, voltage regulation, static and dynamic stability of three-phase systems, and choice of the fundamental elements of a transmission system.

Two appendices—hyperbolic functions and symmetrical components—give an easy review of the mathematical aspects of the subject.

The treatise is remarkably clear and objective, and in the reviewer's opinion takes a very high place among works of the kind. There are minor blemishes in printing, and some of the illustrations are difficult to decipher; but on the whole it is a pleasure to read the book. It covers adequately all electrical aspects of alternating-current transmission, and enables any conscientious reader to design a high-voltage transmission line which would be both safe and economical. Even with the best guidance from books, it has to be recognized that special tests must be made on site before finalizing designs of transmission lines. Two examples illustrate this point. In the case of 70 kV. lines erected more than twenty years ago on the coast of French Morocco near Casablanca, early experience showed that no normal type of insulator would withstand the salt-laden atmosphere which provoked flash-over on such a scale that it appeared probable that the transmission project would have to be abandoned. A remarkably bold and successful solution was found by the local engineers, who improvised oil-filled insulators which saved the situation.

The second case is that of the British 132 kV. Grid lines, which were originally insulated in accordance with the requirements of the empirical formula $(U/15 + 1)$ = number of disks per chain recommended by Signor Dalla Verde. Even with 20 per cent additional insulation, which was provided for in the mechanical clearances, flash-over troubles were so prevalent during fog in industrial areas that the degree of continuity of supply was altogether inadequate. In this case the situation was saved by the use of specially shaped anti-fog insulators which a British firm had developed. The lesson to be deduced is that experience at lower voltages in Great Britain and at the same voltage in other countries proved insufficient warning of the electrical difficulties arising from our peculiar atmospheric conditions.

It is to be hoped that engineers will have an opportunity of bringing to reality some of the projects mentioned at the beginning of this review. Young engineers who may be interested in them could find no better guidance than that provided in Signor Dalla Verde's book.

C. W. Marshall

Chymia

Annual Studies in the History of Chemistry. Tenney L. Davis, Editor-in-Chief. Vol. 1. (Edgar F. Smith Memorial Collection, University of Pennsylvania.) Pp. xiv + 190 + 16 plates. (Philadelphia: University of Pennsylvania Press; London: Oxford University Press, 1948.) 3.50 dollars.

THIS handsome volume, which is a worthy memorial to the late Prof. Edgar F. Smith, well known for his publications in the field of the history of chemistry, contains fourteen articles covering various aspects of the subject. All but one are in English. After a foreword, the essays take up the subjects of Frederick Accum, C. A. Browne, an English alchemical poem, Thomas Thomson, French chemists about 1840, Mendeléeff, potassium chlorate in pyrotechny, the early history of calomel, the concepts of substance and element, the water controversy, Scottish alchemy, the Karlsruhe Congress, and Dulong. There are several plates, and the text is unusually well printed, which, with the attractive binding, makes it a pleasure to read the volume. It is proposed to issue a volume annually, and if further volumes are as good as the first, the editor-in-chief, Prof. Tenney L. Davis, whose own historical publications set a very high standard, may well feel satisfied. All concerned in the production deserve the thanks of chemists who are interested in the history of their subject. The series should be acquired by all chemical libraries, and is a notable contribution to scientific literature.

Chemical Synonyms and Trade Names

A Dictionary and Commercial Handbook. By William Gardner. Fifth edition, revised and enlarged by Edward I. Cooke. Pp. viii + 558. (Kingston Hill: Technical Press, Ltd., 1948.) 50*s*. net.

THE only satisfactory method of reviewing a reference book such as this is to make continued use of it over a period of time, for only in that way can its value really be determined. Following this course, the reviewer has been surprised at the frequency with which trade names turn up during the course of a day, and has been equally surprised at the completeness with which the dictionary has met all demands made upon it. Only very occasionally has it failed; for example, it makes no mention of sulpha drugs, such as sulphapyridine; but the constancy with which it succeeds makes its failure a notable event.

The book will prove of great value to all who have to deal with chemistry and chemicals, and its information is not confined to any particular field of chemistry but embraces all. It is well printed on good paper and is stoutly bound, as a reference book should be.

Organic Syntheses

An Annual Publication of Satisfactory Methods for the Preparation of Organic Chemicals. By R. L. Shriner, Editor-in-Chief. Vol. 27. Pp. vi + 121. (New York: John Wiley and Sons, Inc.; London: Chapman and Hall, Ltd., 1947.) 13*s*. 6*d*. net.

TO the large number of organic chemicals for which reliable preparative methods have been given in this invaluable publication a further list of thirty-nine is now added. As typical examples may be mentioned 3,5-dimethyl-2-cyclohexen-1-one from acetaldehyde and acetoacetic ester, ethyl α-isopropylacetoacetate from isopropyl alcohol and acetoacetic ester in presence of boron fluoride, 3-penten-2-ol from magnesium methyl chloride and crotonaldehyde, stearolic acid from methyl oleate, and tetraiodophthalic anhydride from phthalic anhydride and iodine in presence of fuming sulphuric acid. The statement of directions and precautions, the bibliography for each preparation, and the printing of text and formulæ are all admirable and remarkably free from errors. The cumulative index covers volumes 20–27.

J. R.

The Rare-Earth Elements and their Compounds

By Prof. Don M. Yost, Horace Russell, Jr., and Asst. Prof. Clifford S. Garner. Pp. ix + 92. (New York: John Wiley and Sons, Inc.; London: Chapman and Hall, Ltd., 1947.) 15*s*. net.

THIS little book on the elements of the rare earth group, or lanthanides as they are now called, contains chapters on (*a*) electronic structures and oxidation states, (*b*) magnetic properties, (*c*) absorption spectra, (*d*) evidence for the existence of element No. 61, (*e*) separation of the rare earths, and (*f*) chemical and physical properties of these elements. There is also an appendix on nuclear properties of the rare earth elements. Since the chapters noted above cover only 69 pages, it is inevitable that the subject-matter has been very much condensed, a fact more evident in descriptions of chemical than physical properties. Apart from this limitation, the volume contains much useful and interesting information about this group of elements. The rare earths have received more attention from chemists following the discovery that some of them are formed directly or indirectly in nuclear disintegrations. This book provides a useful introduction to the study of a very interesting series of the chemical elements.

Elements of Nomography

By Prof. Raymond D. Douglass and Asst. Prof. Douglas P. Adams. Pp. ix + 209. (New York and London: McGraw-Hill Book Co., Inc., 1947.) 3.50 dollars.

THAT a straight-edge laid across three coplanar linear scales will serve to express a multilinear functional relation between the indicated scale readings is obvious; if the linear scales are not uniform, more complex relationships can be dealt with. But the step from these simple ideas to the construction of the alignment charts used increasingly in engineering, industry, business and other fields is considerable, and demands skill in design and draughtsmanship as well as in orderly computation. Profs. Douglass and Adams are anxious that the young nomographer should not try to run before he can walk, that he should realize "how small a portion of his entire problem the theoretical solution represents". Thus they begin with a painstaking discussion of scales, occupying six chapters, before starting their discussion of the simpler alignment diagrams in a series of nine short chapters, the last of which deals with the hexagonal diagram for the relation

$$1/x + 1/y = 1/z.$$

There is a short chapter on the use of a circular nomogram for the relation $xy = z$, and a final lengthy chapter on a variety of more complex alignment diagrams, wherein curved scales are employed.

The casual reader who merely wishes to learn a little about nomograms would probably find the pace of this book too slow. But a novice with some strong incentive urging him to master the topic should profit from the careful and detailed discussion, with its valuable practical illustrations.

THE ROYAL SOCIETY SCIENTIFIC INFORMATION CONFERENCE

Introduction

THE Scientific Information Conference held by the Royal Society during June 21–July 2, which was attended by about a hundred and thirty delegates from organisations in the United Kingdom and thirty from the Overseas Commonwealth and the United States in addition to about a hundred observers, was the outcome of a recommendation passed by the Royal Society Empire Scientific Conference of 1946 to examine, in this way, the possibilities of improvement in existing methods of collection, indexing and distribution of scientific literature and of the extension of existing abstracting services.

The importance of the questions involved arises from the overwhelming mass of the literature, which is estimated to total anything up to one million published items a year, apart from the unpublished reports and memoranda which multiply within every scientific establishment and may locally be even more important. This makes it impossible for any individual to scan more than an infinitesimal fraction of what currently appears even within a limited field, or to be sure of finding retrospectively those references which are the most apposite to his own work, unless the indirect means of doing so are highly organised.

Various aspects of the problem have, over many years now, been receiving attention on behalf of the scientific worker through such bodies as ASLIB (a union of the Association of Special Libraries and Information Bureaux with the former British Society for International Bibliography), the International Federation for Documentation, the British Standards Institution and latterly the Technical Information Services Panel of the Committee on Industrial Productivity appointed by the Lord President of the Council. Much useful discussion is to be found in the published proceedings of the first two of these organisations; but along some lines of development—as, for example, mechanical methods of selecting literature references—the position reached is that inventors of machinery and documentary devices have progressed ahead of the ability of the users to tell them what they actually want done. Hence the value of a conference representing primarily the beneficiaries rather than the organisers of information services, and particularly of one at which the special problems that beset scientific men working at isolated posts overseas could receive their due share of attention.

The Conference was organised in four sections to appreciate and discuss what can be done to improve and rationalize the arrangements for:

(1) Publishing and distributing original scientific papers (Editor: Prof. J. D. Bernal).

(2) Issuing and using abstracts to convey current awareness of the availability and relevance of such papers (Editor: Sir David Chadwick).

(3) Consolidating abstracts or other forms of reference into continuously cumulative indexes and using these and other library services for the retrospective searching of the literature (Editor: Dr. J. E. Holmstrom).

(4) Producing and utilizing periodical reviews of progress in designated fields of science (Editor: Prof. H. Munro Fox).

The editors were appointed some months beforehand to take charge of each of the four sections, and they had, with assistance from others, prepared much material for consideration. Terms of reference had been drafted for forty-two specific subjects of study by sixteen working parties. At the opening plenary sessions of the Conference the background to these questions was explained by the editors and the membership of the working parties was made up, each consisting of six to eight persons having special knowledge of the groups of questions they were to answer. In some cases panels of consultants were also listed from which the working parties could co-opt additional members when considering particular questions. The working parties then met separately—except for a few joint meetings where the interests of several overlapped—until the final plenary sessions, when their conclusions and draft recommendations for action on each question were reported to the Conference as a whole for adoption, amendment or rejection. In this way altogether some seventy recommendations were finally sent forward by the Conference to the Royal Society, proposing positive actions either by the latter directly or through appropriate named organisations.

Section I: Publication and Distribution of Papers Reporting Original Work

Section 1 of the Conference had to deal with the publication and distribution of papers containing reports of original work. Papers referring to this prepared for the Conference were essentially of two kinds: those setting out suggestions or expressing opinions, and those containing numerical and statistical information on publication and reading habits. In the first category were the group of papers on Prof. J. D. Bernal's proposed scheme for centralized distribution of scientific papers, criticisms of it by the Physical Society and by the editors of some biological societies, and comments on these views. In the second category were studies on the average length and scatter of papers in different periodicals, on the variety of formats in journals taken at the library of the Royal Botanic Gardens, Kew, on delays in publication; and lists were prepared, after consultation with societies, of the chief journals published in different fields in the United Kingdom and the Commonwealth.

In addition to these, the results of two surveys, one organised by Mr. Urquhart on papers inquired for at the Science Library, and the other of a special questionnaire sent out to research workers in Cambridge, the Department of Scientific and Industrial Research, Rothamsted Experimental Station, the Medical Research Council and various industrial firms. The steering committee of the Section eventually drew up a set of terms of reference for five working parties:

Working Party I/A: (i) To examine the present format of scientific publications and to make recommendations as to the adoption of suggested standards. (ii) To review methods of reproduction of scientific papers and to make recommendations as to the applicability of each.

Working Party I/B: To study the importance of editorial distribution and other factors in relation to the length of scientific communications and to make recommendations as to any desirable changes.

Working Party I/C: To consider whether any advantage would be gained from a more rational

subject grouping of scientific communications within existing journals.

Working Party I/D: To consider the general question of the organisation for publication of original papers and the mechanism for their distribution, and to recommend any steps which may be taken through the co-operation of existing bodies towards achieving any desirable improvements.

Working Party I/E: (i) To examine the present causes of delay in publishing original scientific work and to make recommendations. (ii) To review existing difficulties in the availability of scientific information to men of science, and to make recommendations.

In order, however, to give greater coherence to the work of the Section, the first and last meetings of 'working parties' were joint working parties, and joint meetings of working parties of different sections were arranged on the subjects of photographic reproduction methods and classification.

At the opening plenary session on June 21, with Sir Alfred Egerton in the chair, short statements were made by the editors and the leaders of the working parties and a general discussion followed, with the purpose of conveying to the 'working parties' the views of the members of the Conference. On June 23 there was a special plenary session to consider the replies to the questionnaire already referred to, and to another sent out by Sir David Chadwick on abstract services.

The major conclusions of the questionnaires were of a very decisive character and modified considerably the type of proposals put before the Conference. The most important of these results was that emphasizing the large reliance of research workers on libraries, principally departmental libraries, three-quarters of their reading being derived from this source and the relatively small proportion of reading derived from journals subscribed to by the research workers themselves. It would appear that the average research worker looks through some nine papers a week and reads three carefully, making notes and usually keeping a card index. The paper was read, in 37 per cent of the cases, on account of a reference in another paper and only in 18 per cent on account of an abstract. Reprints furnished 6 per cent of the general reading, but 12 per cent of the careful reading. There were some significant differences between the reading habits of the different sections, those in the applied sciences reading on the whole fewer papers than their more academic fellow workers, and senior workers looking through more papers, but reading fewer carefully, than junior workers. The distribution of reading in various journals was significant: 2,000 papers described as carefully read during the course of the inquiry were derived from 430 different journals; but the distribution of papers consulted among journals varied enormously, one-quarter of the papers being found in six journals, half in thirty, and the last quarter in 330 different journals. This emphasizes a law derived by Bradford from studies of the actual distribution in journals of papers covering particular topics, and shows that his conclusions apply equally strongly to papers actually read. It is also notable that more foreign papers were read than British, and that the great majority of these were American. The major conclusion that can be drawn from these results is that, in the absence of any rational system of distribution of papers by subject, the libraries are the essential agents in the distribution of scientific publications.

The 'working parties' each held a number of meetings which were on the whole remarkably free from controversy, and came to conclusions and recommendations for the most part unanimously. The position of working party I/A was fortunate in that its chairman, M. Lemaitre, had just returned from a meeting of the International Standards Organisation at Geneva and was able to refer the Conference to resolutions already taken on the standardizing of the format of periodicals. The advantage of a limited number of sizes was admitted, and the resolution passed that once these standards were accepted societies would be urged to adopt them whenever they were changing their format. Similar considerations were given to the layout, particularly on such questions as the form of reference and the desirability of beginning each separate paper on a right-hand page to facilitate the issue of reprints and the division of the journal into papers for reference purposes. On questions of reproduction, it was agreed for the most part that printing is the most suitable for large numbers, but that new methods, particularly lithography and the diazo reflex process, might be increasingly used when small numbers are required. The 'working party' put its weight behind the general recommendation for further research on, and development of, methods of reproduction.

'Working party I/B' was on much more controversial ground in its study of the lengths of papers. While there was general agreement that too many papers of a repetitive nature are written, and that papers are longer than they need be, results incorporated in the general resolution of the Section, there was more discussion on the suggestion of extending the practice, already adopted by the Institution of Electrical Engineers and some other bodies, of issuing with the journal a full précis of a length from one-twentieth to one-quarter the original length of the paper, to be issued together as précis-journals covering a cognate group of sciences. The argument for such précis-journals was that they would provide digests of material lying outside the immediate field of any particular worker which would not, in fact, be read unless presented in this shortened form. The argument against it was that the proposal involved the issuing of still further publications and that the field would be covered as adequately by informative abstracts. The 'working party' finally agreed to put forward the suggestion for consideration by the proposed consultative committees of editors suggested by 'Working party I/C'. 'Working party I/B' further considered the need for making provision for the preservation and permanent availability on demand of copies of scientific documents and reports which are too long for publication in the ordinary way. It recommended that some system of deposit similar to that of the Science Service in the United States should be established.

'Working party I/C' was concerned with the grouping of scientific communications within existing journals. This question is very closely connected with that of the classification of science considered more particularly in the other Sections. It was recognized that the scatter of papers on essentially the same subject in journals is very wide; but the 'working party' did not feel competent to indicate precisely how it should be reduced. It is suggested, however, that this could best be done by the setting up of standing consultative committees of editors in cognate subjects, as is already the case for the Biological Council. These

editors might by negotiation arrange among themselves what subjects fell properly within the scope of the particular journal, and which might equally well appear in a small number of journals. In the latter case some provision of exchange of lists of forthcoming papers might present the reader of any particular journal with information as to what is going on in his field far wider than he gets from the journals he can take and far more rapidly than he can get from abstracts. This 'working party' also considered the whole question of the formation of new journals or the extension and division of old ones. It concluded that the latter procedure is on the whole preferable, and that in any event it should not be penalized through the present control of paper supplies.

'Working party I/C' also dealt with two other questions of a more financial nature. It is clear that additional functions for editors, together with the responsibility of producing a paper in a better form (discussed above), would increase the work laid on them. It was recommended that means should be found to provide secretarial and other assistance to editors of journals, particularly smaller journals. The weak financial position of nearly all publishing bodies is clear from the proposal to extend the practice already prevalent in the United States of asking authors to pay for insertion of papers in journals; this was supported by the 'working party' only in exceptional cases, while the Conference itself by a decisive vote was against requests for payment in any circumstances. This, of course, leaves the position exactly where it stands, and if rising costs are not to mean actual restriction of the amount published without regard to quality, the only solution can be through increased grants, either direct from Government or by some form of levy.

'Working party I/D' dealt with the very wide question of organisation of publication of original papers and mechanisms for their distribution. It was originally thought that this working party would deal with the detailed proposals of Prof. Bernal on reprint circulation; but as he himself (as he explained), in the light of the questionnaire on the subject, considered that distribution through libraries is far more important than distribution to individual research workers, this did not come up for discussion. Instead the 'working party' concentrated on the means of obtaining separates directly from publishing bodies or by subsequent copying. The resolution as finally passed by the Conference, after emphasizing the importance of separates to scientific workers, called for a special exploration of the possibility of societies, libraries or commercial enterprises acting as agents for obtaining and distributing such separates. The question of copying separates, which is widely practised in individual cases, came up under the general question of copyright, at a special discussion at the Conference. 'Working party I/D' also emphasized the importance of library and information services, and particularly stressed the need for immediate Government action to provide for the enlargement of central scientific libraries and information services, and for providing for the effective functioning of these by an adequate staff having special qualifications in librarianship and science. It here made special reference to the Patent Office Library, the space in which has not been increased for many years, and to the Science Library. To increase the effectiveness of libraries it also proposed that library committees should co-operate to a greater extent than at present to prevent duplication.

'Working party I/E' had the task of exploring delays in publication and the availability of already published scientific material. It came to the conclusion that the best way of eliminating the former was by closer co-operation between the printing trades and the scientific societies, and in a resolution called on the Royal Society to organise a permanent liaison committee between industry and scientific publishing bodies. The technical means of more rapid publication by alternative methods, particularly lithography, were discussed and the matter referred to a proposed standing committee on the development of reproductive methods (referred to below). Another point stressed by this 'working party' and incorporated in the general resolution of Section I was the need to increase the speed of every stage of the process of the production of a scientific paper, beginning with its actual writing, and passing through its examination by heads of departments, its refereeing and the various stages of actual reproduction and correction. Delay at any stage was felt to have a psychological effect, increasing the probability of delay at other stages. As to availability, particularly in the Commonwealth, this matter was felt to be very largely one of discovery of the whereabouts of the material, and therefore depended on indexing and abstracting. Here proposals for the preparation of lists of titles and abstracts, particularly those emanating from Dominions and Colonies, were made and incorporated in other resolutions of the Conference.

In the general meetings of the Section many points were raised by different 'working parties' so interrelated as to make it desirable to include them in one general resolution. It was proposed that the Royal Society should initiate a vigorous and sustained campaign to improve the preparation and presentation of papers. This would involve action all along the chain of preparation, beginning with the research worker himself, who should be better trained than at present in the technique of writing and preparation of papers for publication. In turn, directors of research might be able to save very much editorial time and trouble at a later stage by careful preediting. Editors themselves, or the publication committees of their journals, were urged to take a more severe line than at present on the acceptance of papers for publication, eliminating so far as possible those that were merely repetitions with variations of papers appearing elsewhere, or those lacking in brevity or clarity of expression.

The recommendations of the 'working parties' were communicated to the plenary session of the Section on June 29, where they were subjected to lively but on the whole friendly discussion. They were for the most part, after certain amendments, accepted by the Conference as a whole, the only point of dispute being the question of the proposed précis-journals which, being a relatively new idea, certain of the delegates would have preferred to be omitted altogether from the resolution.

The full bearing of the recommendations of Section I can only be fully appreciated in relation to the general work of the Conference; but it may be claimed that although no radical changes were proposed, the sectional recommendations indicate in a precise manner what should be done by other bodies to improve the production and distribution of original scientific material. The technical questions were appropriately referred to representative committees which have some reasonable chance of getting their recommendations accepted. On the more

general issues of improved distribution of reprints and a more concentrated and more rational grouping of papers in journals, much will depend on how far it is possible in practice to set up effective working committees of editors who, with the greatest knowledge of their respective subjects, will be most able to set their particular house in order. It is to be hoped that members of scientific societies will also, as a result of the Conference, take more interest than they have in the past in the mechanism of publication, realizing that it is in their own hands to modify, and that it is not some divinely imposed order which they must accept without complaining.

J. D. BERNAL

Section 2: Abstracts and Abstract Journals

On the shelves of the Athenæum Club is a series of annual volumes, politely styled, "The Works of the Learned". The date of the first is 1699. They are informative abstracts, longer than those now usual yet true to type. Abstracts of scientific papers are certainly not new. Yet the decision of the Royal Society to devote one main section of its Conference to the consideration of abstracts and abstracting services is likely to prove timely.

The keynote of the Conference was service to science and to the scientific worker. Abstracts exist to serve the scientist. That is their sole justification. The English-speaking peoples are the chief producers of scientific abstracts. The journals of some of the United Kingdom abstracting services have appeared without a break for more than seventy years. The number of those services has increased markedly in the last twenty to thirty years. Yet this Conference was the first occasion on which representatives of most of those services had met together as a group to consider how far they were serving the needs of science as a whole, how their methods and techniques agreed or differed and in what respects such variations detracted from extended use of their journals and labours. What also was most certainly new was to have available at such discussions the assistance and criticism of scientific workers of most varied interests and of representatives from the Dominions overseas, from the United States and from the United Nations Educational, Scientific and Cultural Organisation. This alone ought to make this Conference worth while in the long history of abstracts; but what was really surprising came out in the early days of preparation for the Conference, namely, the almost complete lack of factual information about the existing abstracting services, and of how scientific men, in their differing circumstances and in their different branches of science and its applications, actually used abstracts and for what purposes. Was their chief purpose to provide 'current awareness', making speed of issue the prime requisite and their useful 'life' comparatively short? Or were they often consulted over periods of five, ten or even twenty years, in which event obviously good subject indexes, and where possible consolidated five- or ten-year indexes, were a great advantage? Was it broadly true that while an informative abstract is invaluable to the scientific worker far from a good library, as one working in a Colony, the indicative type of abstract generally meets the needs of anyone in the United Kingdom? Precise answers to such questions must vary in different branches of science, but are enough facts known to afford any general guidance or lead to abstracting agencies as a whole?

Opinions were numerous on how abstracts should be written, how indexed, on their type, on their excellence in some cases and failures in others, on their 'gaps' and 'overlaps' and on the difficulties in borderline subjects; but facts were few. This was inevitable, for surprising though it may seem, no list of the abstract journals published in the United Kingdom was readily available; consequently, no ready information on the branches of science and of its applications they, as a whole, presumed to cover. It is not suggested that any scientific men could or would have occasion to refer to all the abstracting journals. He knows one or two, and may at times be referred by his librarian to others; but if no ready information of their general coverage is available, he can scarcely be expected to refer to a journal the title of which may be vaguely familiar to him although he may be ignorant of its scope. The plight of a scientific man overseas wishing to use United Kingdom abstracts is greater.

Factual information had been collected from many of the abstracting agencies. This was presented to the Conference in condensed form, also the results of some inquiries into the use of abstracts. The Conference, however, realized broadly how the present services had grown up, their general character, the experience gained and knowledge orderly accumulated. It referred the whole subject to three 'working parties'; one to examine the place of abstracts in the service of scientific workers, their relation to other forms of service, such as reviews, bibliographies, etc., and to review the existing services; a second composed mostly of representatives of the abstracting agencies to compare their methods, techniques and practices; and a third to look to the future.

A paper presented by the Science Library, London, showed that notices in abstracts probably cause most inquiries for copies of original papers (possibly a third of the total), closely followed by references to papers in other papers. Prof. J. D. Bernal's pilot survey in Cambridge and elsewhere placed it lower at one-sixth. A small-scale but very welcome voluntarily organised inquiry in the University of Birmingham showed a preference of more than three to one for informative abstracts, and that about one-third of new papers were discovered through abstracts. Other information suggested that informative abstracts were more used in the United Kingdom than might have been thought. But all these inquiries were on too small a scale to give any reliable indications. Also, to be useful, they would need to be broken down according to the different branches of science and its application. A diagrammatic representation of the inter-relations of science and the scope of existing abstract agencies which Dr. H. J. T. Ellingham had prepared showed at a glance present gaps and overlaps. Gaps, time-lag and indexing were the chief subjects of complaint.

One fairly recent change in the type of user came out, arising from the extended use of science in organised industry. This is the increased reliance of many scientific workers on the 'information officer' for help in searching and in obtaining literature. The information officer thereby becomes another and constant user of abstract journals. Also, such are the extensions of the use of science in industry that many abstracting agencies may not have included these officers as users of their journals. Abstracts have always been designed to serve particular groups of scientific workers directly, and the various abstracting services look on their work from that angle; but as

this tendency extends, consideration of the needs of these information officers as potential users of their journals becomes important.

As regards the abstracting services, the facts collected brought out several points. Most of the published abstracts are of the informative, that is, longer, more detailed, type. *British Abstracts*, the largest single service, are of the brief, or indicative kind. Nearly all are on a non-profit earning basis. This means that behind each is some sponsor society or department. It thus follows that the phrase 'abstracting agencies or services' cloaks many variations of functions or duties. The functions of any agency are those laid down or approved by its sponsor society or department. These may be confined to the preparation and issue of abstracts, as with *World Abstracts of Medicine*; or, as with the Tropical Diseases Bureau and the Commonwealth Agricultural Bureaux, they may be those of centres of information entailing aid in preparing reviews, in obtaining reprints or copies of papers, or translations or even in identifications. The issue of the abstract journal then becomes one of several duties and not a sole function. The agencies are not thus all of one type or origin, capable of easy recasting or reshuffling. They differ in function, type, scope and finance. But they all have this basal characteristic in common: each has been called into being at the instance of scientific men, engaged in some branch of science or of its application, to serve their particular needs; each is responsible to (and ultimately controlled by) scientific men in its sponsor society or department.

In each case responsibility for the abstract journal rests on scientific workers trained in that subject. Control may become difficult in particular cases; but the identification of a service with those engaged in a particular branch of science or of its application should foster service of a type suitable to its needs and the maintenance of quality and accuracy. This identification of a service with a particular group carries a corollary. The primary loyalty or allegiance of any abstracting agency is to the scientific workers in its sponsor society or department. The Conference showed no desire to disrupt such associations, or to subject them to outside authority, for the sake of a general uniformity. To have done so would have been to ignore differences between the needs of different branches of science, and the fact that in some agencies overseas interests are active participants; yet an indefinite increase in the number of isolated independent services must lead, in the ever-increasing inter-relationships of science, to overlapping and confusion rather than to clarification. Responsibility to a particular group or branch is in no way incompatible with better service to science as a whole. The operative portions of the Conference's terms of reference to the third working party, that looking to the future, were then: "To consider and report, with recommendations if desired, on the advisability, cost, organisation and functions for a Council on Abstracting, not to centralize all abstracting, but as a continuing agency, to promote co-operation between abstracting services, the elimination of gaps . . ."

It was with this background of facts and ideas that the 'working parties' started on their labours. It was impossible in the few days at their disposal to solve definitely all the points which arose. This was especially so in the second 'working party' where, for the first time, abstracting agencies had met to examine their methods. Differences undoubtedly existed. To adjust those so as to secure a wider use of their journals is a continuing task and not one to be settled in a few preliminary meetings. They therefore presented their findings to the Conference chiefly in the form of conclusions, rather than recommendations. The first 'working party' also presented most of its findings by way of conclusions. The conclusions and recommendations were placed later before the Conference, were discussed, passed, amended, or rejected by it. The leaders of the three 'working parties' were Dr. H. G. Thornton, Mr. B. Fullman, and Dr. G. M. Findlay; the recorders Dr. M. A. Vernon, Mr. J. Beak and Dr. B. M. Crowther. All 'working parties' had the help of representatives from the countries overseas and from the United States. Mr. J. B. Reid, of the United Nations Educational, Scientific and Cultural Organisation, brought to Working Party No. 3, looking to the future, the latest information on international developments.

The conclusions reached by the Conference should, if followed, improve the general usefulness of abstracts. A few only can be mentioned here. Some overlapping between abstract services is desirable, when the services cater for readers having different interests. Such overlap is distinct from duplication. For this reason a single set of abstracts produced by a central agency would not suffice for universal use. Publication of abstract journals, covering identical fields and directed to the same type of user, constitutes duplication and is to be deplored. The quality of abstract indexes is frequently unsatisfactory. Abstracting services, unless combined with an information service, as is often desirable, cannot be expected to answer specific inquiries on literature. By way of comment on this point, it may be explained that this conclusion merely reflects the differing functions of these services, as already explained. All realized that the usefulness of abstracts is gravely impaired if the means for obtaining copies of the original papers are inadequate. This question kept reappearing in all sections of the Conference, and is undoubtedly one of prime importance.

Among the recommendations was a strong emphasis on the need for comprehensive subject indexes to be provided with each volume; and a recommendation that consolidated subject indexes be provided at intervals. But the chief recommendation adopted by the Conference was that on co-operation in the future. It was to the effect that the Royal Society be invited to consult the abstracting agencies to set up a standing consultative committee of abstracting organisations for mutual exchange of views and generally to promote co-operation. The Committee should consist of representatives of bodies responsible for the production of journals of abstracts. It should work on a voluntary basis and the cost be kept low. Among earlier matters for its attention were listed, increasing uniformity in the services in the methods of bibliographical citation, the maintenance of a comprehensive list of journals of abstracts, the question of its publication and the possibility of including in it an indication of the general scope of each journal, the possibility of co-ordination of systems of indexing, the determination of fields where readers' needs are inadequately met, and the maintenance of a panel of abstractors with special linguistic knowledge.

If this standing committee is formed—and all the main abstracting services were in favour of it—many questions besides those tabulated will come before it,

though those when worked out should greatly extend the knowledge and usefulness of abstracts. Not only will this be the first time that these agencies have met to exchange information and experience, but also such meetings and consultations will have a definite object, namely, to promote co-operation in the service of science generally. An aim has been given. This recommendation may thus become among the most constructive from the Conference in this Section. It is certainly timely, in the light of the increase in the number of these services, the increased efforts in applying science, the general stir for better organised dissemination of information and the revived interest of the possibilities of co-operation on the international level. On this the Conference, while recognizing the difficulties, urged organisations covering similar fields to make efforts at closer collaboration.

The conclusions and recommendations of the Conference in this matter of abstracts may not seem so wide or so drastic as some might have wished; but though much testimony was given to the utility of present services, the striking characteristic of the Conference was this—no question was approached from a particularist point of view. The obvious desire of all was to secure better service to the scientific worker; to build on what had been learnt, but to harmonize and adapt it so as to be even more effective in the service of science. The long history of abstracts to meet the needs of science is not closed—perhaps, indeed, a new phase is opening; the particular services will continue, for the needs of scientific men in different branches and in different circumstances must vary. But while preserving all that is most useful in that respect, conscious collaboration in the interest of science as a whole will constantly grow, so that the journals become more widely known, more easily used, borderline cases provided for, and needless diversities of practice eliminated.

In all this the visitors from overseas played an active and stimulating part. When discussing abstracting, the needs arising from one's own local conditions and circumstances are apt to be so prominently and even fatally in one's mind as to distort the conception of what must be in some degree a general and not an individual service. The overseas delegates helped to keep this needed balance.

DAVID CHADWICK

Section 3: Indexing and other Library Services

Whereas Section 2 of the Conference was concerned in securing awareness of current publications, Section 3 dealt with the provision for retrospective searching: the problem of how to dispose literature references in such a way that those among them which may help to satisfy any particular quest for information liable to arise in the future will be turned up, when the time comes, with certainty and speed.

This problem includes what is normally understood by librarianship, and also goes far beyond it in magnitude and complexity. A librarian in the traditional sense is occupied with the procurement, store-keeping and cataloguing of books as complete units; but not with analysing their contents or indicating their relevance. Yet a single book, journal article or patent specification may touch on many subjects and be important from many points of view; and the mere fact that a library which holds a copy of it has catalogued it under its author and title, or even under such multiple subjects as may be implicit in the title, goes only a very little way towards what is required. The problem of documentation is, in fact, to ensure that when a scientific man needs to find out what has already been done and thought regarding any topic whatever, he can quickly be given the most apposite references not only among the hundreds of thousands collected in his own departmental library but also among the millions available to him, by way of loan or photo copy, from the libraries of the world at large.

Any one of these may turn out to be the one which would best serve the interests of some future inquirer, if only he knew of its existence, by enabling him to begin his own researches from a more advanced starting point. There being no means, however, of foreseeing which item that will be, there are needed economical techniques for the mass processing of the greatest possible range of literature references to meet the contingency that any one of them may be of value. Fundamentally, there are four ways, each with its variations and its advantages and disadvantages, along which this central problem can be attacked:

(1) Indexing the names of subjects in alphabetical order. This is the usual system in books and at the end of each year's run of a journal; under certain conditions it is satisfactory also for card indexing. But it involves many more difficulties and moot points than are apparent at first sight. It has the effect of dispersing logically contiguous items according to the letters of the alphabet with which their names happen to begin, and as the names are not standardized so as to make them mutually exclusive, a searcher is liable to look in vain for something which the indexer has buried elsewhere under a synonym.

(2) Classifying the subjects themselves under symbols which serve to pinpoint their positions in a logically constructed map of knowledge. Many such classifications are in use, some locally for special fields of subject-matter and some general like the Universal Decimal Classification, which is an internationally standardized extension of the Dewey system developed by librarians for shelving books. On this system, knowledge as a whole is divided into ten primary branches each denoted by a first decimal number, each of these into ten subdivisions denoted by a second decimal, each of the latter into ten sub-subdivisions denoted by a third decimal, and so on to whatever degree of particularization is required. As the sequence of subjects is ideographic, not alphabetic, an alphabetically arranged key (corresponding to the gazetteer in an atlas) is necessary for locating subjects when only their names are known.

(3) Coding the subjects under symbols which can be represented by patterns of holes punched in a card, or by patterns of dots detectable by optical means alongside a microfilm of the document under reference. Items so coded can be stored in random order and run through a machine, when required, which automatically picks out those of them which have been coded in any particular way.

(4) Coding the shapes of certain classes of objects under symbols which can be treated as above. The Dyson and the Gordon–Kendall–Davison systems of chemical notation enable this to be done for the arrangement of atoms in a complex molecule, which makes possible the mechanical selection of references to chemical compounds according to their molecular structures.

As staff and resources for bibliographical work are limited, the application of any of these methods must be governed by a proper balance of time and effort between indexing or classification on one hand and searching on the other. The greater the chance of references of a given kind being of future interest, the greater the justification for the labour of analysing them minutely and of consolidating those of different dates and sources into a single cumulative index. Where, however, a subject is unlikely or seldom likely to be of interest, it is more economic to rely on making an *ad hoc* search if and when the occasion for it arises, even though this may involve the tedious job of consulting the separate annually published indexes of many separate journals in which references might be found. Elaboration of indexing is, in fact, an insurance, and just how big a premium it is worth must depend on circumstances.

Two of the working parties in Section 3, dealing respectively with classification and with mechanical methods, drafted recommendations which the Conference adopted on various practical aspects of this central problem.

The Universal Decimal Classification, it was held, has both advantages and limitations. Among its assets are the millions of existing references so classified and the many thousands being published every year with the class numbers already printed on them; these are among the justifications for continued extension in its use. But the criticisms to which it stands exposed were recognized also and led the Conference to favour setting up a standing committee for fundamental research into subject classification of science without pre-commitment to any particular system. Further study and research on alphabetical arrangement were also recommended.

Similarly a full-scale experiment on mechanical methods of selection was urged, as well as encouragement of the Aslib committee which is studying and collating progress in this field. A particular device, exhibited at the Conference, which the working party found of interest though no positive recommendations was made about it at this stage, was the invention of Dr. J. Samain of Paris: this has a typewriter-like keyboard whereby up to 24 six-letter words can be punched directly in a single card, and a selector able to pick out those cards which carry any desired word or combination of words regardless of the position or sequence in which these occur on particular cards.

On the question of chemical notation suitable for punching on cards, the Conference recommended that the attention which appropriate bodies are giving to one system be extended also to others proposed.

Another working party studied photographic and other new methods of reproduction. These have many important uses in bibliographical work, and the Conference recommended the establishment of an advisory committee to stimulate and watch developments in Great Britain and in other countries. As an example, it is an obvious economy if index items or abstracts which are required to be circulated sequentially in page form and also to be cumulated separately in card form can be reproduced in both forms without having to typeset or typewrite them (and check them) twice over. In the United States this is now widely practised. Another recommendation of the Conference which depends for its economy on suitable methods of reproduction was the issue from a central source of guide cards bearing Universal Decimal Classification numbers, for insertion direct into card indexes instead of having to copy them locally from a list. Again, in the United States the Library of Congress issues printed catalogue cards for all the books it handles, which hundreds of other libraries can use instead of having to do the work over again locally. Steps to develop such a service in Great Britain were recommended.

Among the new methods of reproduction studied and commended by the Conference was a Dutch process of diazo-printing (much cheaper than photography using silver chemicals) which enables not only direct copying from single-sided translucent originals but also, by a reflex method, copying from double-sided or opaque originals including the pages of bound books. This system has the further immense advantage that processing of the exposed paper is dry (or practically so) and therefore instantaneous, so that one or many copies of any document can be obtained, as and when required, in an ordinary office.

Various questions affecting the use of microphotography were studied, including the supersession of continuous lengths of film by strips or other more convenient units. Apart, however, from technical points like this, the great possibilities latent both in microphotography and in full-sized photo-copying for assisting the dissemination of scientific literature are governed more than anything else by restrictions resulting from the present copyright law. To give only one instance: if these could be removed by legislative reform, or circumvented by some form of agreement with authors' or publishers' organisations, the production and distribution of separate offprints of articles printed in journals would be greatly facilitated. The copyright question was discussed by the Conference at considerable length, and a recommendation was put forward stating the necessity for the provision of single copies of extracts from books and periodicals for purposes of scientific research and inviting the Royal Society to initiate action in the matter.

A fifth working party, which considered data tables, reference books and guides to information services, compiled a useful bibliography of these works. The Conference recommended continued action to ensure that scientific compendia in all fields of science were available and up to date, and to assist their publication where necessary. Financial aid to speed a new edition of the "ASLIB Directory" was urged, and a hope expressed that the "World List of Scientific Periodicals" might be re-issued as early as possible. The Conference recommended compilation of a British work corresponding to "Industrial Research Laboratories in the United States and Canada", and also of a subject index to the research activities and specialized knowledge of individual men of science.

Some 40 per cent of the world's scientific publications are in languages other than English; hence the importance of the questions referred to the sixth working party of Section 3, which considered translation services. As a result of its labours the Conference recommended greatly increased publicity for the ASLIB Register of Specialist Translators, which enrols only persons who combine linguistic knowledge with knowledge of particular branches of scientific or technical work; also its extension to those qualified to act as interpreters, by the simultaneous method, at international scientific conferences. Other recom-

mendations included the institution of university or other suitable diplomas in translating and interpreting, the establishment of a central location index to unpublished translations, and that the Government be asked to consider action to modify the Berne Convention on international copyright so as to allow organisations such as the Science Museum Library to make available any translations deposited with them.

J. E. HOLMSTROM

Section 4: Reviews and Annual Reports

Reviews of a critical and constructive nature, written by leaders in particular branches of science, are of the greatest value, and senior investigators should regard the production of these as an important ancillary to the pursuit of new knowledge. The fields covered by critical reviews depend upon the first-class reviewers available at any given time. Such reviews, written by specialists, can be made very informative to workers in allied fields by the inclusion of an introduction and conclusion of a general, and as far as possible non-technical, nature. The desirability of the inclusion of the titles of papers in the bibliography of reviews and other scientific papers varies with the science; it is desirable in biology, possibly less so in chemistry.

Annual or biennial reviews, progress reports and books on recent advances serve a useful purpose, especially if prepared as critical reviews rather than synoptic summaries. Reviews written by specialists for workers in other branches of science are of great importance and at present are insufficient. In the applied sciences there is also a need for more review publications. In this connexion considerable material could perhaps be made available for publication by the larger industrial concerns.

Reports on 'symposia' are recognized as a valuable contribution to the recording of progress in science but are not a substitute for reviews or annual reports. A wider distribution of copies of the more important review lectures is desirable.

H. MUNRO FOX

THE PALESTINE FLORA

By ERIC HARDY

THE trouble in Palestine sets back the clock on the recent efforts of both Arab and Jewish gardeners to develop the horticultural attractions of the Holy Land, for the palm boulevards of Jaffa, and the flower-growing settlements at Mishmar-Hasharon, etc., had attracted much praise and attention. The danger, however, goes deeper, for modern Palestine was not the primitive wilderness of brigand and bedouin as depicted in most of the Western religious books. Several excellent gardens and plant collections were in the country, and their future is threatened by the bitterness of war. There is, for example, the best of the attempts to create a typically English garden, with its lawns and roses, its rockery and its pergola, which was in the grounds of Government House on the dry and dusty hill outside Jerusalem. On besieged Mount Scopus the botanical department of the University of Jerusalem housed the finest herbarium of the Near East flora, with more than 300,000 sheets of specimens collected not only in Palestine, but also in Syria, Arabia, Transjordan, and in particular the desert regions. There was also the private collection of Palestine and Transjordan plants collected in the American Colony in Jerusalem by J. E. Dinsmore, editor of the second edition of Post's "Flora of Palestine and Syria", where also the garden of a score of varieties of Palestine irises was a famous feature in April. Another internationally famous private herbarium, the largest outside the University, is the Herbarium Boyko, housed at the village of Talpioth, between Jerusalem and Bethlehem, in the home of Dr. Hugo Boyko, its compiler, an official of the Mandatory Government's Department of Forests.

At Rehovoth, which has been subject to several air raids, are housed the laboratories, collections, trial gardens, etc., of the country's main horticultural research. Here Dr. Oppenheimer, Dr. Samech and others maintained the vast organisation of the citrus research and the fruit-growing industry, where East Malling ideas were developed and plants acclimatized and tested. The horticultural edition of the *Palestine Journal of Botany* is produced here under Dr. Oppenheimer's editorship, while the purely botanical edition is produced at the University of Jerusalem under Prof. Zohary's editorship.

In recent years the University of Jerusalem had established a botanic garden on Mount Scopus, mainly for shrubs and trees typical of the country's flora, and including a coppice of cedar of Lebanon. Under the Mandatory Government, the Departments of Forests and Agriculture maintained several stations existing from Turkish times, like the vineyards, date palms and orchards at the old Turkish horticultural station in Jericho, and they established others. Near Acre the Mandatory Government established its main stock farm and horticultural and field crop station; its station for deciduous trees, carobs, vines and pruning instruction was near Safad. At Farawana, near Beisan, in the middle Jordan Valley, it had a station for sub-tropicals, olives, vines and dates; another near the historic Jacob's Well at Nablus for olives, vines and pomegranates; an experimental station for miscellaneous work was at Majdel, and a forestry station at Gaza that has been planting a large acreage of wind-blown sand with tamarisk to check the inroads of the Sinai sandstorms. From these stations, Arab gardeners were taught Western ideas of grafting and pruning, particularly for olive cultivation. The famous Arab olive orchards at Beit Jala near Bethlehem, and their pomegranate orchards near Ramallah, were a tribute to the work.

On the cool and fertile shores of southern Galilee, the Jews maintained a remarkably interesting nature study and agricultural institute called Beth Gordon, in memory of a pioneer settler, Aaron Gordon. This was at Degania settlement, in the vicinity of much of the recent fighting between Tiberias Jews and the Iraqi Army. Beth Gordon (or Gordon House) was open to any visitors interested in natural history or horticulture irrespective of membership. It maintained laboratories, lectures, a card-indexed library of 12,400 books in several languages, a museum with 18,500 animal specimens and a herbarium of 3,400 named plants, all under the direction of M. J. Palmoni. This was mainly a teaching centre, whereas Rehovoth was the main centre of horticultural research and plant acclimatization.

For several years the European colony in Jerusalem maintained a Jerusalem Horticultural Society, and in 1928 it published an instructive little booklet on the cultivation of gardens under those high, dry, chalky

conditions. But war has sapped much of its energy and activity. The municipality of Jerusalem had initiated a few excellent little public gardens in recent years, gardens of begonias, *Lantana*, *Iris* and a strange mixture of Western formality and sub-tropical flowering shrubs, together with a small nursery for re-stocking these gardens, placed at the foot of the Mount of Olives.

It is true that in recent years Palestine-grown flowers were on exhibition in London and at Detroit; but Palestine has nothing to compare with Egypt's famous Gardens of the Nile near the Delta barrage. Jerusalem is a difficult place for the gardener, as its high position entails a seasonal variation from almost sub-tropical summer to winter snows and frosts. But since the mandate the temperature of Jericho in the hot lower Jordan Valley has been made much cooler for its inhabitants by the extended cultivation of trees, for both their floral effects and their fruit, irrigated with the sparkling waters of Elisha's spring. The first cultivators of the Jericho desert were the Greek monks, whose monastery orchards adjoining the tamarisk thickets just north of the Dead Sea are several hundred years old. In more recent years the Jewish settlement at Beth Ha'arava, beyond the recently destroyed Palestine potash plant on the north shore of the Dead Sea, 1,300 feet below sea-level, has cultivated a former salt-desert by leaching the soil with pipe-borne sweet water pumped from the nearby Jordan. The French Trappist monastery at Latrun, scene of bitter fighting for the Jerusalem–Tel Aviv highway, has developed some of the finest vineyards and orchards in the country, and its wines are nationally famous.

The main problem facing horticulture in Palestine was lack of water; but in recent years I saw how much of this difficulty had been conquered by the establishment of concrete aqueducts in the middle Jordan Valley, pumping sweet-water on to the Dead Sea salt-lands, and damming up by earth and concrete reservoirs the occasional but heavy winter rain that filled the wadis in the southern Negev desert. Artesian wells were much used in the coastal area, where practically all the great citrus-growing orchards were cultivated; but a generation or two ago, sandy wastes covered this area.

The pomegranate, the vine and the fig were already under cultivation by the native Arabs when the ancient Israelites first invaded the Holy Land. The Israelites introduced the apple, the first fruit to be mentioned in any historical writings, for Ramsis II had planted this native of the Black Sea in his gardens in the Nile Delta. The Jews traditionally introduced the citron to Palestine from their Babylonian captivity, and the Arabs are said to have brought the lemon and the orange to the Mediterranean coast from Iraq in the tenth century. Modern research into the history of the citrus fruits has, however, shown that oranges and lemons were known in Palestine in Mishnaic times, and the coins struck by Simon Maccabæus shortly after he conquered Jaffa in 136 B.C. show the citron was then in cultivation there.

The Western world has been indebted to Palestine for many of its irises. I have seen iris Grant-Duffii, the laurel and *Lilium candidum* growing wild in the Carmel area. The profusion of the garden anemone, *A. coronaria*, *Cyclamen persicum*, *Tulipa montana*, *Narcissus Tazetta*, the golden *Sternbergia aurantiaca* and of *Cistus* shrubs has borne offspring to grace countless gardens in Europe and America.

OBITUARIES

Profs. Friedrich Oltmanns and Adolf Pascher

SOME tribute should be paid to Profs. F. Oltmanns and A. Pascher, both of whom died in 1945 after making substantial contributions to the advancement of algal studies during the present century.

The name of Oltmanns, who for many years occupied the chair of botany in Freiburg in Baden, will be remembered as that of the author of the first comprehensive account of the Algæ. His "Morphologie und Biologie der Algen", published in 1904, constituted a landmark in the study of the Algæ and, by making available an authoritative account of the group, stimulated and had a far-reaching effect upon algal investigation in many different directions. The more extensive second edition, which appeared in 1922–23, was less inspired, and its utility was marred by the inadequate and frequently erroneous literature citations. The extensive treatment accorded to algal biology in the third volume failed to give a clear insight into the many outstanding problems.

Oltmanns, however, has other claims for inclusion among the outstanding algal workers of his period. He was the first to elucidate clearly the role of the auxiliary cells in Florideæ, and we owe to him considerable contributions to the knowledge of the Fucales and of the conditions of life of seaweeds. A special volume of the *Zeitschrift für Botanik*, which he edited for many years, was published in 1930 when he reached the age of seventy years.

Pascher, who was born in 1881, spent the whole of his academic life at the German University of Prague, where, during the latter part of his life, he occupied the chair of botany. His influence on algology was of a different and more profound nature than that of Oltmanns. One of his earliest researches, published in *Bibliotheca Botanica* in 1907, was concerned with the morphology and behaviour of the swarmers of diverse filamentous Chlorophyceæ. It was probably these studies that aroused his interest in flagellate organisms, to the knowledge of which he was to make so great a contribution. His investigation of the rich flagellate and algal flora of the Central European uplands extended over a period of more than thirty years, and resulted in the description of innumerable genera and species new to science.

An early outcome of these studies was the recognition of the fact that flagellate groups like the Chrysomonadineæ and Dinoflagellata (Peridinieæ) include also coccoid and filamentous types, comparable to those already known among the Chlorophyceæ and Xanthophyceæ (Heterokontæ), though Klebs in 1912 had already to some extent advanced this point of view for the Peridinieæ. In the brief memoir entitled "Ueber Flagellaten und Algen", published by Pascher in 1914, however, the Flagellata as a whole were placed in their correct relation to the Algæ, and the theory of the flagellate origin of Green and Yellow-green Algæ, first propounded in 1901 by Bohlin, was extended to the new classes Chrysophyceæ and Dinophyceæ. Emphasis was also laid on the remarkable degree of parallelism evident between the various algal series emanating from flagellate sources. These diverse theses were more fully elaborated in a series of papers published during the next twenty years, dealing with Chrysophyceæ, Dinophyceæ, and Xanthophyceæ, in which fundamental knowledge of each class was appreciably extended.

The great debt which botanical science owes to Pascher is the elucidation of the diverse lines along which algal evolution from flagellate stocks has taken place and of the definite pattern followed in this evolution. His numerous papers, however, include many other important contributions to the knowledge of Protista. Outstanding among these are the extensive studies of amœboid and rhizopodial forms of Algæ, which first disclosed clearly the significance of amœboid organisation, the exposure of the manifold relations between pigmented and colourless flagellate organisms, and the recognition of the affinity between Diatoms, Chrysophyceæ and Xanthophyceæ.

Later generations will no doubt also acknowledge the debt owed to Pascher in respect of the publication of the "Süsswasserflora", which probably gave an even greater stimulus to freshwater algology than did Oltmanns' book. Pascher's own contribution to this series of volumes was very considerable, and includes some of the most valuable parts. It is much to be deplored that he did not survive to produce a second edition of the volumes dealing with the Flagellata, of which he had so unrivalled a knowledge. His last comprehensive publication was the volume on Heterokontæ in Rabenhorst's "Kryptogamenflora", which was completed in 1939.

Pascher's numerous papers are characterized by lucidity and by the excellence of the accompanying illustrations, although sometimes a little marred by hasty editing. Most of his work was published in the *Archiv für Protistenkunde* and the Beihefte of the *Botanisches Centralblatt*, of both of which he was editor for a long period of years. His was a lovable, though sometimes rather impetuous, personality.

F. E. Fritsch

Mr. H. Brearley

Mr. Harry Brearley, the inventor of stainless steel, died on July 14 at the age of seventy-seven. A native of Sheffield, and the eighth child of a family brought up in "Ramsden's Yard", of which he has given a vivid account in a delightful autobiography, "Knotted String", he had only an elementary school education and then worked as a cellar lad in a crucible steel works. He was fortunate in being taken from this to be a laboratory boy under a capable and kindly analyst, who persuaded him to attend evening classes. He married young, and quite early collaborated with Fred Ibbotson in a book on the analysis of steelworks materials. In 1914 he went to Riga, then a Russian town, as chemist in a steel works associated with Messrs. Firth of Sheffield, where he improved the technique of hardening armour-piercing shells, having also to act as managing director when the Russian Revolution came and many members of the staff left. On returning to Sheffield he took charge of the Brown–Firth Laboratory, installed jointly by two neighbouring firms. Difficulties in the making of armour plates led him to the further study of the thermal treatment of alloy steels.

His introduction of a steel containing chromium with low carbon was intended to provide a more durable lining for gun barrels, and it was the observation that specimens in the laboratory, under certain conditions of heat treatment, were highly resistant to corrosion that suggested their use for cutlery. A Sheffield firm, R. F. Mosley, produced knives made of this steel which were not stained by fruit acids or similar solutions. Difficulties arose over the ownership of the invention, and in 1915 Brearley left the firm and joined Messrs. Brown Bayley, also of Sheffield. For a time, the patents were controlled by a special organisation, the Firth–Brearley Syndicate. Patent litigation involved a visit to the United States. Brearley retired in 1925 to Torquay. He and his brother devised the method of studying ingot structure by casting and sectioning wax models. He was awarded the Bessemer Gold Medal of the Iron and Steel Institute in 1920.

Without a university training, Brearley had a remarkable command of lucid English, and his books are models of their kind. A man of sturdy independence, a lover of good literature, and a metallurgist who rendered great services to the steel industry and to the men employed in it, he has a strong claim to be remembered among pioneers in industry.

C. H. Desch

We regret to announce the following deaths:

Dr. William Cullen, well known for his work in mining engineering and explosives, on August 14, aged eighty-one.

Prof. Beatrice Edgell, emeritus professor of psychology, Bedford College, London, on August 10, aged seventy-six.

Dr. Alexander Smith, assistant mycologist at the Ministry of Agriculture and Fisheries Plant Pathology Laboratory, Harpenden, on July 23, aged fifty-four.

NEWS and VIEWS

Chair of Entomology, University of Illinois: Prof. G. Fraenkel

Dr. G. Fraenkel, lecturer in physiology in the Department of Zoology and Applied Entomology at the Imperial College of Science and Technology, London, has been appointed professor of entomology in the University of Illinois, Urbana, Ill., to take charge of the newly founded sub-section of insect physiology. Dr. Fraenkel, who was educated at the University of Munich, was an assistant in the Department of Zoology in the Hebrew University, Jerusalem, during 1928–30. During 1931–33, he was *Privatdozent* in zoology in the University of Frankfurt. From 1933 onwards, he has carried out research in insect physiology and the orientation of invertebrates at University College, London, and the Imperial College. Dr. Fraenkel has held his post as lecturer in physiology in the Imperial College since 1938. Most of Dr. Fraenkel's researches have been confined to insect physiology, including reflexes, pupation hormone of flies, function of halteres of flies, properties of cuticle and respiration. Since 1940 he has made a comprehensive study of insect nutrition supported by the Royal Society and, later, by the Medical Research Council. During the spring and early summer of 1947 he was guest professor in the University of Minnesota, where he gave a course of lectures on insect nutrition.

The National Radium Trust and Commission

With the coming into force of the National Health Act on July 5, the affairs of the National Radium Trust and the Radium Commission are being wound

up. The two bodies were established by Royal Charter issued under Letters Patent of July 25, 1929. The functions of the Trust were primarily to augment the supply of radium (and later, by supplemental Charter, other radiotherapeutic apparatus) for use "in relation to the treatment of the sick in Great Britain" and "the advancement of knowledge of the best methods of rendering such treatment". The main duty of the Commission was "to make arrangements for the proper custody, equitable distribution, and full use of the radium . . . of the Trust with the object of promoting the treatment of the sick . . . and to make such arrangements for the supply on loan of the radium . . . as are necessary". When the Commission started work it was generally admitted that radium treatment in Great Britain had not attained the standard then reached by such centres as the Fondation Curie and the Radiumhemmet. During the last nineteen years, however, some of the national (university) radium centres set up by the Commission have achieved a reputation equal to the best anywhere in the world. At the same time, the standard of radiotherapy in general has been raised by the policy of centralization pursued by the Commission. Hospitals with small radiotherapy departments have been advised to make agreements with a national centre for the treatment of their patients, and the formation of small independent centres has been consistently discouraged. The present health organisation requires that the work hitherto done by the Trust and the Commission shall in future be undertaken partly by a Ministry of Health committee, and partly by the regional hospital boards. It is deemed advisable, therefore, that the radium and other radioactive substances, apparatus, appliances, funds and property belonging to the Trust and the Commission shall be dealt with by vesting them in the Minister of Health, or the Secretary of State for Scotland, as may be appropriate. The Royal Charter and the three Supplemental Charters are to be surrendered.

Market Research

THE report of the Conference arranged by the Manchester Joint Research Council in Manchester on October 22, 1947, on "Market Research", has now been published (Manchester Joint Research Council. Market Research: Report of the Conference held on Wednesday, October 22, 1947, at the Albert Hall, Manchester. Pp. 108. (Manchester: Manchester Joint Research Council, 1948.) 2*s*. 6*d*.). It includes the full text of the three papers "The Technique and Applications of Market Research", "The Investigation of Trends of Consumer Tastes" and "Market Research and the Seller" submitted by Mr. O. W. Roskill, Mr. L. R. England and Mr. D. S. F. Vernon, respectively, together with their statements in presenting these papers and reports of the discussions. Summing up the discussions and the papers Mr. C. C. Renold said that, according to this composite picture, the broad purpose of market research was to provide answers to the questions, what does the customer, in fact, want, and, what is he likely to want in the future? These two questions immediately led to four others: who is the customer, what does he, in fact, buy, what is it that determines or influences his choice, and how much does he buy? The answers to some of these questions can be sought by statistical means; but, especially with consumer goods, other questions lead us into problems of psychology. The answers, too, have to be in two tenses—present and future—and they are determined not only by general movements of economics, trade or social habits, but also by the position of the manufacturer in relation to his competitors. The essential in market research was to select the subject most worth close examination by the techniques available. Mr. A. H. S. Hinchliffe, pointing out that the Manchester Joint Research Council did not itself undertake market research, referred to its information bureau as of possible service to firms unaware of sources of information or market statistics and as possibly able to advise firms on the best sources and consultants for carrying out particular pieces of market research.

Recently Introduced Fungicides

LIME-SULPHUR and Bordeaux mixture, both discovered in the last century, are still very effective and relatively cheap sprays for the control of fungus diseases. It is natural, however, to investigate the possibilities of other substances which might be either more effective or more economical. R. W. Marsh has carried out an extensive series of fruit-spraying trials with various new fungicides (*J. Pom. and Hort. Sci.*, **23**, 3 and 4, Dec. 1947). Phenyl mercury chloride was approximately equal to standard lime sulphur for the control of apple scab; in Grade E oil emulsion, it also gave promising inhibition of sporing of *Monilia fructigena*. Ferric dimethyldithiocarbamate and tetramethylthiuram disulphide are not phytotoxic, but are inferior as fungicides to lime sulphur. Heptadecylglyoxalidine equalled lime sulphur for apple scab control, and did not damage sulphur-sensitive varieties. The last substance, with dichlornaphthoquinone and dithiocarbamate sprays, gave satisfactory control of *Pseudopeziza* leaf-spot of black currants. Spread of brown rot infection of apples was reduced by ferric dimethyldithiocarbamate; but hydroxyquinoline sulphate showed no fungicidal value for apple scab.

Diseases of Mushroom Cultivation

THE Mushroom Growers' Association is a body formed by a particular section of the horticultural industry in order to solve its own pressing problems. Some interesting features relating to mushroom diseases have recently appeared in the Association's Bulletin (Nos. 11 and 12, April and July, 1948). 'Cobweb', caused by overgrowth of beds by *Dactylium* species, is briefly described by Fred C. Atkins. The control of 'bubble', caused by the fungus *Mycogone perniciosa*, is outlined by Edmund B. Lambert. He regards as necessary a complete programme: burning sulphur and fumigating with formalin before the mushroom houses are used, taking water direct from uncontaminated deep wells, attaining a temperature of 120° F. for 48 hr. in the final fermentation of manure and casing soil, and general methods of hygiene. A new leaflet of the Association (No. 3) describes the general characters of *Mycogone* disease. A detailed account of the invasion of mushroom beds by truffles is contributed by A. M. Kligman, and, as control of most mushroom diseases involves rigid methods of hygiene, the necessary measures are considered in detail by R. L. Edwards and C. J. la Touche.

Cosmic Phenomena of the Past

IN a paper, "Further References to Cosmic Phenomena in the Kitāb Al-Muntazam of Ibn Al-Jauzī, and a Few in Tārīkh-E-Rāḥat Afzā (India)", a

reprint from *Islamic Culture*, April, 1948, Mohd. Abdur Rahman Khan provides a short account of thirteen fireballs from A.D. 983 to A.D. 1031; three comets from A.D. 974 to A.D. 1056; a comet in A.D. 1741, a detonating fireball in A.D. 1742, and another one in A.D. 1757 and an earthquake at the same time (it is conjectured that the earthquake may have been due to the impact of a large meteorite with the ground), and a slight earthquake in A.D. 1759. This information is additional to that published by the same author in his brochure "Meteoric Showers, Past and Present", some of which was discussed by him in the *Islamic Culture Magazine*, **20**, 4 (1946).

Scottish Conference on Road Research

An all-day conference to discuss road research problems will be held in Glasgow at the Royal Technical College on September 24. The conference is being called, with the collaboration of the Ministry of Transport, by Dr. W. H. Glanville, director of road research of the Department of Scientific and Industrial Research, in association with the Glasgow and District Association of the Institution of Civil Engineers, the Scottish branches of the Institution of Municipal Engineers and the County Surveyors' Society, and the Scottish Accident Prevention Council. The chairman of the conference will be Sir Patrick Dollan. The purpose of the conference is to bring the work of the Road Research Organisation before Scottish engineers and others concerned with roads and road traffic, and to provide an opportunity for discussing which research problems are of particular interest to Scotland. In addition to short papers by the director of road research and senior members of his staff, followed by an open discussion, there will be an exhibition of some aspects of the work of the Organisation. The morning session (deputy chairman: Colonel T. U. Wilson) will be devoted to materials and methods of construction, and the afternoon session (deputy chairman: Mr. G. J. Sherriff) to road safety and traffic flow. Owing to limitations of space, admission will be by ticket, obtainable from the Director of Road Research, Road Research Laboratory, Harmondsworth, West Drayton, Middlesex.

University of London: Appointments

The following appointments in the University of London have recently been announced: Dr. T. Crawford, University professor of pathology in St. George's Hospital Medical School as from October 1. Since 1946 he has been director of pathological services at St. George's Hospital and Medical School; Mr. D. V. Davies, University professor of anatomy in St. Thomas's Hospital Medical School as from October 1. Since 1944 he has been fellow and College lecturer at St. John's College, Cambridge, and in 1945 was Arris and Gale Lecturer at the Royal College of Surgeons; Mr. A. V. Judges, University professor of history of education in King's College as from January 1, 1949. Since 1938 he has held the title of reader in economic history in the London School of Economics and Political Science; Dr. R. T. Williams, University professor of biochemistry in St. Mary's Hospital Medical School as from October 1. Since 1942 he has been senior lecturer in biochemistry and during 1943–44 was in charge of the Department of Biochemistry at the University of Birmingham; Dr. G. L. Clark, University reader in mathematics in Bedford College as from October 1. Since 1947 he has been senior lecturer in mathematics at University College, Cardiff; Mr. T. A. Rodger, University reader in psychology in Birkbeck College as from October 1. He is at present senior psychologist to the Admiralty, consulting psychologist to the Central Juvenile Employment Executive and a lecturer in Birkbeck College.

Announcements

Mr. Derek Allan Hough has been appointed general secretary of the Institute of Petroleum with effect from September 1. Mr. George Sell has been appointed as editor of the Institute's publications with effect from August 1. Mr. Sell has been publications secretary since March, 1946.

Prof. Walter H. Bucher, of Columbia University, has been elected president of the American Geophysical Union to fill the unexpired term of the late Oscar E. Meinzer. This term will expire on June 30, 1950.

Mr. F. A. Secrett has resigned his position as honorary adviser to the Ministry of Agriculture and Fisheries on vegetable production, with effect from August 1. Mr. Secrett, who is himself a leading vegetable grower, has held this appointment since August, 1942. He will continue his membership of the Agricultural Improvement Council.

In recognition of his studies on "Sludged Blood" the College of Physicians of Philadelphia has awarded the Alvarenga Prize for this year to Dr. Melvin H. Knisely, of the University of Chicago. The Alvarenga Prize was established by the will of Pedro Francisco da Costa Alvarenga, of Lisbon, Portugal, an associate fellow of the College, "to be awarded annually by the College of Physicians on each anniversary of the death of the testator, July 14, 1883".

The Electronics Division of the U.S. Electrochemical Society is making preparations for a symposium on luminescence, to be held during its meeting in Philadelphia, from May 5 until 7, 1949. Further information can be obtained from Dr. R. M. Burns, Electrochemical Society, 235 West 102 Street, New York 25, New York.

The Nuffield Foundation has provided funds for the establishment of a research fellowship in extraction metallurgy, which will be awarded in consultation with the Institution of Mining and Metallurgy and the Royal School of Mines, London, and will be tenable at the Royal School of Mines for a period of five years. The funds are sufficient to provide a small specialist staff and the necessary equipment in addition to adequate remuneration for the fellow. Further information can be obtained from the Secretary, the Institution of Mining and Metallurgy, Salisbury House, London, E.C.2.

The Medical Research Council announces that it has awarded Rockefeller travelling fellowships in medicine to the following, for the academic year 1948–49: Dr. K. W. Donald, Medical Professorial Unit, St. Bartholomew's Hospital, London; Dr. L. P. R. Fourman, Nuffield Department of Clinical Medicine, University of Oxford; Dr. R. H. Girdwood, Department of Medicine, University of Edinburgh; Dr. A. Isaacs, Department of Medicine, University of Sheffield; Mr. A. I. S. Macpherson, Department of Surgery, University of Edinburgh; Dr. H. B. Stoner, Department of Pathology, University of Sheffield; Mr. S. F. Taylor, Department of Surgery, Postgraduate Medical School, London.

LETTERS TO THE EDITORS

The Editors do not hold themselves responsible for opinions expressed by their correspondents. No notice is taken of anonymous communications

Origin of Some Plant Viruses

POTATO paracrinkle virus, discovered by Salaman and Le Pelley[1], has been found in every plant of the variety King Edward that has been examined, but never in other varieties in the field, although it can be transmitted to them by grafting. The inference is that it has no natural means of spreading, and must have been present in the original seedling from which the variety King Edward came.

It is reasonable to infer that the virus was in the seedling because it was a seedling, and either is part and parcel of the clonal variety, or arose during some phase in the life of the seedling not shared by plants propagated vegetatively. The first alternative is ruled out because the virus is not transmitted by seed and behaves in general like other viruses, as Carson *et al.*[2] pointed out in reply to Darlington's suggestion[3] that the virus was a protein constituent of the variety. This leaves the second, which means that the virus arose in the germinating seed or very young seedling, because these are the only phases in the life of a seedling that are not shared by plants propagated vegetatively.

There is evidence for the belief that potato paracrinkle virus is not unique in its origin, and that other plant viruses may have arisen in germinating seed.

The biochemical processes during germination are to some extent the reverse of those during the formation of the seed—food reserves built up in the seed are broken down during germination—and if viruses arose during germination there would be a fair chance that they would be destroyed in the seed as it forms. This is precisely what happens, for destruction of those viruses that manage to enter the seed seems universal, even if it is sometimes incomplete. The suggestion that viruses have arisen from occasional syntheses during germination is the simplest explanation of this destruction.

It might be argued that the prevalence of viruses in plants propagated vegetatively is against the suggestion; but this is not so, because one can usually trace a connexion with propagation by seed. Consider the largest two groups of plant viruses: those of stone fruits and of potatoes. Stone fruits are usually (but not invariably) budded on seedling stocks; and, granted a susceptibility of *Prunus* towards viruses, there is (on the present suggestion) the ideal combination for the establishment of new viruses: seedling stocks to produce them and vegetative propagation of varieties to give them a less poor chance of survival. Potatoes are nowadays raised from seed only for the production of new varieties (with the consequence in King Edward already noted). But the raising of new stocks from seed was once common in Europe as well as in the original home of the potato; and it may be significant that, whereas several of the viruses of stone fruits discovered in recent years were not only previously unrecorded but, on local evidence, apparently new, there is no evidence that outside South America the potato viruses, with the exception of paracrinkle virus, are modern.

On following the line of thought in the second half of the previous sentence, it was found that the number of virus diseases first recorded in the literature after the publication of K. M. Smith's "Textbook" in 1937, relative to the number recorded before, is significantly greater for plants usually grown from seed or on seedling stocks than for plants usually propagated only by vegetative means. Details of the test of independence are given in Table 1, which is based on the 156 viruses contained in Wiltshire's[4] list published in 1946, the classification being made on the host plants which give the viruses their common names, and on the dates when the diseases were first recorded, irrespective of whether they were then ascribed to viruses or not. An identical trend is also shown in Table 2, which, to remove any bias that vegetative propagation may give to the detection of virus diseases, is confined to vegetatively propagated plants, and compares plants like peaches, which are usually on seedling stocks, with plants like potatoes, which are usually propagated by simple vegetative means, or, like roses, on stocks raised vegetatively. The records of plant virus diseases are still fragmentary and perhaps unrepresentative, and the host plants after which the viruses are named are sometimes clearly not the original hosts, but the difference between the two sets of records as they now stand is unquestionable. Closer analysis of the effect of time revealed no evidence that the choice of date, 1937, had much to do with this difference.

Table 1. Number of first records of plant virus diseases. Figures in parenthesis are for woody and herbaceous plants respectively

	Plants grown from seed or on seedling stocks	Plants propagated vegetatively	Total
Before 1937	68 (19, 49)	52 (18, 34)	120 (37, 83)
1937 and after	31 (13, 18)	5 (3, 2)	36 (16, 20)
Total	99 (32, 67)	57 (21, 36)	156 (53, 103)

χ^2 for all plants = 10·35; for woody plants = 4·17; for herbaceous plants = 6·80. The 1 per cent and 5 per cent points are 6·64 and 3·84 respectively.

Table 2. Number of first records of virus diseases of plants which are usually propagated vegetatively

	Usually on seedling stocks	Usually vegetative propagation only	Total
Before 1937	12	52	64
1937 and after	11	5	16
Total	23	57	80

χ^2 = 15·62; 1 per cent point = 6·64.

It is not supposed that all diseases recorded since the beginning of 1937 are new, even if, to allow for the inevitable lag in time between the synthesis of a virus and the discovery and record of the disease it causes, one interprets the adjective as covering the last few decades. But it is possible that enough viruses are new enough to influence the date of discovery of the diseases they cause, and thus, if they arise in the seed, to give the records the trend they have. Fortunately, the analysis is one which will automatically improve as records become less fragmentary, and time will allow one to give the possibility a better test.

To conclude, it is suggested that the synthesis in healthy tissue of enough virus to effect further multiplication is a rare event which happens in the protein-rich seed during the intense chemical activity of germination. Rarity is a clear demand of the statistical argument, one successful synthesis followed

by successful dispersal being all that is really needed for each virus; and this demand allows a theory of heterogenesis to conform with the substance of the teachings of Pasteur.

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Pretoria.
March 2.

[1] Salaman and Le Pelley, *Proc. Roy. Soc.*, B, **106**, 140 (1930).
[2] Carson, Howard, Markham and Smith, *Nature*, **154**, 334 (1944).
[3] Darlington, *Nature*, **154**, 164 (1944).
[4] Wiltshire, *Rev. Appl. Mycology*, **24**, 515 (1946).

Rh Genes Allelomorphic to *D*

STRATTON[1], in 1946, described an *Rh* gene allelomorphic to *D* and *d*, to which he gave the name D^u. He demonstrated that this allelomorph was inherited in the same way as the other *Rh* genes. During the last two years we have had the opportunity of testing twenty-eight samples of blood of the genotype $D^u d$, nineteen of which were from unrelated English persons.

The tests were exhaustive; they included titrations in saline and in albumin against numerous anti-*D* sera, and tests by the anti-globulin and by the elution techniques. We consider a sample of blood to be $D^u d$ if it gives some of, but not all, the reactions expected of *D* when tested by these various methods against the battery of agglutinating and incomplete anti-*D* sera. The homozygote $D^u D^u$ must be very rare in England, and in the heterozygote $D^u D$ the presence of D^u is masked by that of *D*.

Red cells		12 anti-*D* Sera											
Da.	$CD^u e/cde$	−	−	−	−	+	+	−		−	−	−	−
Sh.	,,	−	−	−	−	+	+			−	−	−	−
Am.	,,	−	−	+	+	+	+	+	+	+	+	−	−
Br.	,,	−	−	+	+		+	+		+	+	+	−
Ma.	$cD^u e/cde$	−	−	+	+	+	+	+		+	+	+	+
Bl.	$CD^u e/cde$	−	+	+	+		+	+		+	+	+	+
CDe/cde control		+	+	+	+	+	+	+	+	+	+	+	+
Lo.	$CD^u e/Cde$	−	+	+	+		+	+		+	+	−	−
Mar.	$cD^u E/cde$	−	+	+	+		+	+	+	+	+	−	−
Ab.	,,	−	+		+		+	+	+	+	+	−	−
Gr.	$CD^u e/cde$	−	+	−	+		+			+	−	−	−
Cu.	$CD^u e/Cde$	−	−	−	+		+	+		+	−	−	−
Th.	$CD^u e/cde$	−	−	−	+	+	+	+		+	−	−	−
Gl.	$CD^u e/Cde$	−	−	−	+	+	+	+	+	+	−	−	−
Se.	$cD^u E/cde$	−	−		+		+	+		−	−	−	−
Le.	$CD^u e/cde$	−	−	−	+		+	+	+	−	−	−	−
Jo.	,,	−	−	−	−	+	+	+		−	−	−	−
Po.	$CD^u e/Cde$	−			−	−	+						−
Ho.	$CD^u e/cde$	−	−	−	+		−	−	−	−	−	−	−
Pi.	,,	−	−	−	+		−	−	−	−	−	−	−

The reactions of the blood of the nineteen unrelated English persons with twelve anti-*D* sera are shown in the accompanying table. The twelve sera had each disclosed slight variations in the specificities of their anti-*D* when they were tested against the nineteen samples of blood. About thirty antisera were used; but the rest appeared to give the same reactions as one or other of the twelve. Conversely, the antisera defined twelve different types of $D^u d$ blood, and presumably if the battery of antisera had been larger, more of the nineteen samples of D^u blood would have been distinguishable.

Examination of the families of ten of the nineteen persons confirmed Stratton's views of the inheritance of D^u; but it went further, and left very little doubt that the fine distinctions between the different types of D^u are also genetically determined, for with one exception the blood of related persons gave identical D^u reactions.

The apparently unlimited number of D^u allelomorphs, together with the very arbitrary way in which the antisera were reacting with them, recalled the work of Dubinin on the many allelomorphs at the scute locus in *Drosophila melanogaster* (as described by Waddington[2]). The problems seemed to have sufficient in common to stimulate us to seek, by rearranging our results, for some such pattern as that into which the scute results apparently fitted. This could be done by cutting up the original most bewildering table first vertically for the sera; then, having decided on their order, redrawing the table and cutting it horizontally for the ordering of the cells. The result was the striking pattern shown in the table. It will be seen that two samples of blood do not fit in at all, but that the remaining seventeen show a horizontal and vertical contiguity of positive reactions uninterrupted by intervening negative ones. There is only one exception to this, in the horizontal direction, about halfway down the table.

It is difficult to decide whether the pattern is a chance one. If it is significant, then the horizontal conjunction of positive signs seems to impose a linear order on the different forms of D^u. It suggests that if the differences between the D^u's are due to mutations, then the mutations may be additive in nature. The vertical conjunction of positive reactions would suggest that an anti-*D* antibody is built up according to a progressively expanding plan.

It should be mentioned that D^u is much too rare to have been the antigen responsible for the immunization of the twelve mothers whose sera are shown in the table. Probably all these anti-*D* sera were made in response to the antigen *D*. It should also be made clear that all twelve antisera would agree in giving positive or negative reactions with at least 99 per cent of blood samples. It is only over the rare D^u bloods that they disagree. The range of an anti-*D* serum in agglutinating D^u cells is not wholly dependent on the titre of the serum, though there is a positive relationship between range and titre.

The different D^u samples can be graded from those that are agglutinated in saline by most anti-*D* sera down to those which can only be recognized as having any D^u component by giving a positive anti-globulin test with incomplete anti-*D* serum. Blood of the latter type will usually have been classified as *Cde/cde* or *cdE/cde*.

The *C* or *c*, *E* or *e* genes with which D^u is usually combined in England strongly suggest that the mutation to D^u, if it is a mutation, occurs to a *D* gene rather than to a *d* gene.

The type of blood called $R^r r$ (and the same applies to $R'r$) consists of two groups probably differing fundamentally in origin. One group, perhaps the larger, is really antigenically low-grade D^u and is of the genotype $CD^u e/cde$, which we consider has arisen by mutation in a *CDe* chromosome. The other group contains the true *Cde/cde*, which, according to the suggestion of Fisher for which there is some striking support, has arisen as a cross-over between *CDe* and *cde* chromosomes.

A detailed account of the family and serological investigations will be reported elsewhere.

We are indebted to many *Rh* workers for sending us samples of D^u blood and anti-*D* sera. Particularly we would like to mention Dr. F. Stratton, Dr. F. S. Stewart, Mr. I. Dunsford and Dr. A. E. Mourant.

R. R. Race
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April 10.

[1] Stratton, F., *Nature*, **158**, 25 (1946).
[2] Waddington, C. H., "Introduction to Modern Genetics" (London, George Allen and Unwin, 1939).

In 1945 a cell sample was discovered reacting with only a proportion of anti-*D* sera. This suggested a new allele of *D* which was called D^u [1]. 209 *Rh* antisera stored at − 20° C. for periods up to several years have been tested with D^u cells of types CD^ue and cD^uE, selecting the appropriate cell to avoid the effect of anti-*C* and anti-*E* agglutination in sera containing more than one antibody. 102 of these sera contained anti-*Rh* agglutinins, and 37 of these (36 per cent) agglutinated D^u cells, some weakly, some very strongly. These sera all contained anti-D + anti-D^u agglutinins; anti-D^u by itself has not been detected. 71 of these agglutinating sera were free from anti-*C* and anti-*E* agglutinins, and 27 of these (38 per cent) agglutinated D^u cells. These 27 comprised 13 per cent of all the sera tested. The remaining 107 sera contained incomplete antibodies, many of which were weak; and 36 of them (34 per cent) gave positive Coombs tests with D^u cells. Eight of these gave positive albumin tests also, and five sera gave positive albumin tests only. In addition, strong incomplete *Rh* antibodies from ten cases of incompatible transfusion all gave positive Coombs tests with D^u cells, as did ten agglutinating sera which gave negative agglutination with D^u cells.

D^u cells vary in the strength of their reactions and in the number of agglutinating sera with which they react; and some are negative with all agglutinating sera, so that R_1 (CD^ue) and R_2 (cD^uE) may only be distinguishable from R' (*Cde*) and R'' (*cdE*) by the positive Coombs tests which they give with certain incomplete anti-*D* sera, especially those from cases of incompatible transfusion. A series of strongly positive albumin tests, on the other hand, suggests that the cell is an ordinary *Rh* positive one and does not contain D^u, since D^u only rarely gives positive albumin tests with incomplete anti-*D* sera.

The best method of investigation has proved to be the comparison of the reactions of various cells with a large number of sera, and we have examined fifty cell samples mostly thought to be R' (*Cde*) and R'' (*cdE*) in the first instance. They were tested with forty-nine agglutinating sera, and with fourteen incomplete anti-*D* sera, employing the Coombs test and albumin test. Detailed results will be published elsewhere; but a selection is given in the accompanying table. D^u cells vary in strength from very weak reactors to those which are scarcely distinguishable from ordinary *D* positive cells.

It will be observed that the D^u antigen in cell No. 39 can only be detected by the Coombs test. This cell gave negative albumin tests even with three specially selected incomplete anti-*D* sera which gave strong albumin tests with more strongly reacting D^u cells, such as cell No. 13.

Several samples of maternal blood of group R' (*Cde*) or R'' (*cdE*) containing *Rh* antibodies were examined; but no evidence of the presence of D^u was found. For this reason, and since van Loghem[2] found that D^u could be antigenic to an *Rh* negative person, D^u is considered to be *Rh* positive and should be excluded when selecting *Rh* negative blood donors. The most practical way to do this as a routine is by the use of anti-*C* and anti-*E* sera in addition to the use of several anti-*D* sera. This will exclude the vast majority of D^u positive cells. D^u also has a practical importance in that R_1 (CD^ue) and R_2 (cD^uE) cells are readily mistaken for R' (*Cde*) and R'' (*cdE*); and if such cells are used for testing purposes, one may falsely be led to suppose that agglutinating or blocking sera contain anti-*C* or anti-*E* antibodies in addition to anti-*D*.

Inheritance of D^u has been demonstrated, but we are at present making more family studies to substantiate the hypothesis that D^u is a term covering a series of alleles or modifications of the *D* antigen at the *D*—*d* locus.

Since sera which agglutinate D^u cells do so to a lower titre than the same sera agglutinate cells containing the ordinary *D* antigen, and since absorption of sera with either *D* or D^u cells does not effect any separation of the antibodies anti-*D* and anti-D^u, it might be thought that the phenomena were quantitative and dependent on a varying amount of the *D* antigen in the cell. However, this cannot be the case since the sera which agglutinate the greatest number of D^u cells are not always those with the highest titres when tested against cells containing the *D* antigen, and since cases have been found where, of a pair of sera, only one agglutinated one sample of D^u blood while the other agglutinated the second.

Type of serum	Agglutinins								Incomplete antibodies						
	Anti-*C*	Anti-*D*						Anti-*E*	Coombs test Anti-*D*			Albumin test Anti-*D*			
Serum No.	19	35	37	40	20	28	16	43	11	7	9	11	7	9	
Cell No.															Conclusion
1	−	64	64	4	16	16	4	++++	++++	++++	++++	+++	+++	+++	R_2 (*cDE*)
13	−	8	8	1	1	−	−	++++	++++	++++	+++	−	−	−	R_1 (cD^uE). Strong reactor
23	−	2	1	1	−	−	−	++++	++++	+	++++	−	−	−	R_2 (cD^uE). Medium reactor
15	++++	W	−	W	−	−	−	−	++++	−	++++	−	−	−	R_1 (CD^ue). Weak reactor
39	−	−	−	−	−	−	−	++++	+++	−	++	−	−	−	R_2 (cD^uE). Weak reactor
14	++++	−	−	−	−	−	−	−	−	−	−	−	−	−	R' (*Cde*)
8	−	−	−	−	−	−	−	++++	−	−	−	−	−	−	R'' (*cdE*)

Number of +'s indicates strength of reaction. W = weak. − = negative. Figures indicate the titre of strongly positive reactions.

Nevertheless, it was found that the sera with the highest titres for *D* cells were frequently good agglutinators of D^u, so that it does appear that a serum containing a strong anti-*D* agglutinin is more likely to react strongly with D^u.

When antigens like *D* and D^u are closely related, the possibility of a cross-reaction of each antigen with antibodies produced against the other is high. This shows that while a quantitative element is involved, there are also distinct qualitative differences between *D* and D^u.

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May 27.

[1] Stratton, F., *Nature*, **158**, 25 (1946).
[2] van Loghem, *Brit. Med. J.*, II, 958 (1947).

Viropexis, the Mechanism of Influenza Virus Infection

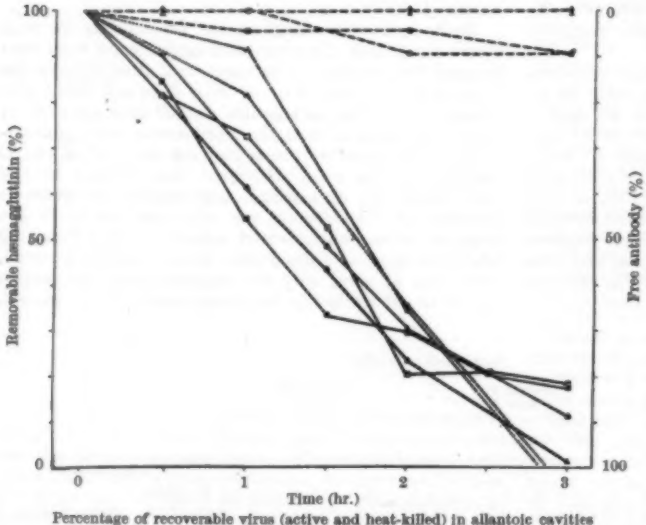
Cellular receptors capable of reacting with influenza viruses (such as those on erythrocytes, and the cells lining the respiratory tract of the mouse or the allantoic cavity of the chick embryo), when treated with appropriate amounts of periodate, still adsorb virus; but spontaneous elution does not occur nor can artificial liberation be induced by the 'receptor-destroying enzyme' of *V. choleræ*, an agent known to remove bound virus from normal receptors. On the basis of a detailed study, it was concluded that the substrate for the receptor-destroying enzymes of the virus or vibrio is altered by periodate ions without significant change in the adsorptive capacity of the receptor area, so that the contact of such treated cells with virus results in an irreversible receptor-virus combination[1]. In further experiments it was shown by four independent methods, both in mice and developing chick embryos, that despite 'modification' by periodate, infection takes place through such receptors; obviously, these conditions do not allow of any enzymatic action of the virus on the receptor substance[2]. The uptake of the particle adsorbed to the exoplasm of the future host cell is believed to be a process essentially similar to the phenomenon of colloidopexis.

Since the objection may be made that this mechanism is at work only on receptors previously modified by periodate, further experiments using heat-killed virus and normal receptors were carried out.

The allantoic fluid of living eggs was removed, and replaced by physiological sodium chloride solution containing a standard amount of active or heat-killed (30 min. 56° C.) Lee virus. At intervals ranging from 0 to 180 minutes, a potent receptor-destroying enzyme preparation was inoculated to remove virus still present at the surface of the cells. The fluids were harvested at the end of the fourth hour, and titrated for their agglutinin content. The experiment was repeated with eggs the allantoic lining of which had been killed by formaldehyde. The percentage of removable virus at different intervals is given in the accompanying graph.

In a second series of experiments, use was made of the fact that specific antibody combines with virus only outside the cell. The second inoculum in this case contained antiserum sufficient to neutralize the amount of virus—active or heat-killed—given in the first inoculum, and the drop in anti-hæmagglutinin titre served as a measure of virus present at the surface of the cells or in the fluid. The experiments were performed on normal, formolized and periodate-treated eggs.

From the graph it is clearly seen that both active and heat-killed viruses disappear from allantoic cavities with living cellular lining, irrespective of whether the receptors are normal or modified by periodate. In formolized cavities, that is, cavities lined with dead cells, all the virus is recovered. Obviously, the penetration by the virus of the cell membrane does not depend on the viability or enzymic activity of the infective particle, but only on the functional integrity of the host cell.



Percentage of recoverable virus (active and heat-killed) in allantoic cavities lined with living or dead cells

—— Untreated eggs, living; .... periodate treated eggs, living; – – – formolized eggs, dead.

□ active virus, ■ heat-killed virus } receptor-destroying enzyme liberation technique

△ active virus, ▲ heat-killed virus } antibody neutralization technique

Each point represents the average from 36 eggs

The 'enzyme-substrate combination hypothesis', recently reiterated by Hirst[3] on no better evidence than originally proposed[4], cannot be accepted in the light of the above findings. All Hirst's experiments to elucidate the mechanism of infection were performed on non-living systems or on non-host cells, the strongest proof in favour of his assumptions being the momentary lack of contradictory evidence.

The above results, taken together with the fact of influenza infection through periodate-modified receptors, suggest a different mechanism. Specific adsorptive combination between the cellular 'receptor area' and the viral 'combining area' ('B-spots' in the terminology of Burnet[5]) is followed by the

ingestion of the infective particle. This phenomenon strongly recalls the uptake by cells of colloidal dyes, and may therefore be termed 'viropexis'. Enzymic activity and destruction of receptors—formerly postulated as prerequisites for the penetration of the virus into the interior of the host cell—do not seem to be essential, though possibly the invariable occurrence in natural infections with enzyme-possessing viruses.

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June 27.

[1] Fazekas de St. Groth, S., *Aust. J. Exp. Biol.* (in the press).
[2] Fazekas de St. Groth, S., and Graham, D. M., *Aust. J. Exp. Biol.* (in the press).
[3] Hirst, G. K., *J. Exp. Med.*, **87**, 301 (1948).
[4] Hirst, G. K., *J. Exp. Med.*, **76**, 195 (1942).
[5] Burnet, F. M., *J. Path. Bact.*, **39**, 285 (1934).

Polyploidy in Bacteria?

In the course of experiments on the bactericidal action of X-rays on the *R* and *S* phases of *Escherichia coli*, it was found that the survival-rate in three stocks (76, 111, *Ida*), irradiated twenty-four hours after seeding, was different[1]; one of them (stock *Ida*) was more resistant to the radiation as compared with the other two stocks. No significant differences were found between *S* and *R* phases of the same strains. According to the hit-theory of biological effects of radiation the survival-rate is a measure of the target volume, which has been assumed to represent the bacterial 'nucleus'[2,3]. If in the case of bacteria the so-called nucleoplasmic ratio of plants and animals holds true, and if, on the other side, the target volume obtained from X-ray experiments really represents the size of the bacterial 'nucleus', one would expect the size of the bacterial cells to be correlated to the target volumes. A biometric analysis of twenty-four hours old bacteria, carried on the projected images of photomicrographs of bacteria stained with Henrici's Congo Red method[4], has shown that *E. coli* with a larger target volume are larger than the ones with smaller target volume. The variability curves obtained for the three stocks were almost normal, and the differences found between their means were statistically significant. It is suggested that such correlation might indicate the presence of polyploidy among different stocks of the same bacterial species, as it has previously been found in other organisms. A detailed description of such experiments will be published elsewhere.

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Occurrence of *Talorchestia brito* on the Coast of Northumberland

Talorchestia brito was originally described by Stebbing in 1891 from specimens collected on the north Devon coast[1]. No further records of its occurrence on the coasts of Britain can be found, though, according to Chevreux and Fage[2], it has been recorded from a number of scattered points on the Continent from the eastern English Channel to the western Mediterranean. It has now been found about three hundred miles north of any previous record near Blyth, Northumberland, being moderately common between high-water neap and high-water spring tides in the coarse sand to the south of the town. The species appears to be restricted to this stretch of about two miles, and has not been found on any other sandy beach in Northumberland or north Durham.

On July 6, 1948, the population of *T. brito* consisted of adults, including females carrying eggs, and recently hatched young. *Talitrus saltator* was also present, but was much less abundant.

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Laminaria ochroleuca De La Pylaie Growing on the Coast of Britain

On April 10, 1946, a *Laminaria* plant, trawled in Plymouth Sound and brought into the Plymouth Laboratory by Miss M. F. Sutton, Department of Biology, Chelsea Polytechnic, was identified by me as *Laminaria ochroleuca* De La Pylaie, a species of *Laminaria* that had not previously been recorded from the coasts of Britain. As trawling over the same ground on subsequent days failed to procure further plants of this species, the record was not published. A recent survey, however, has shown that this species occurs quite frequently in the more sheltered parts of Plymouth Sound. It is found on rocky ground from just below, down to eight metres below, low water spring tides, growing usually with *L. cloustoni* Edmondst. or *Saccorhiza bulbosa* De La Pylaie.

L. ochroleuca can be distinguished at any time of the year from *L. digitata* (L.) Lamour. and *L. cloustoni* Edmondst. by the colour of the base of the frond, which is always whitish-yellow, and by the smooth stipe which contains mucilage canals in the outer layers. During the spring and early summer, when frond growth is very rapid, the whole frond is a pale yellowish-brown; but during late summer, autumn and early winter, when growth is slower, the distal part of the frond becomes darker, the distinguishing whitish-yellow colour being noticeable only at the base.

L. ochroleuca (= *L. lejolisii* Sauvageau, *L. pallida* (Grev.) J. Ag. var. *iberica* Hamel, *L. iberica* (Hamel) Lami) is recorded from the western Mediterranean and from the north-eastern Atlantic. On the French side of the Channel it is recorded at localities from Finistère to Cotentin. There are also records of its occurrence in the Channel Islands.

Dr. Robert Lami, of the Muséum d'Histoire Naturelle, Paris, who has worked on the distribution

of this species on the French coast[1], informed me in 1945 that he thought this species might have 'crossed the Channel' and invaded the south coasts of England and Ireland because of its abundance on the coast of Brittany. Plants up to five years old are now present in Plymouth Sound; but it is not known how long this species has been there. It was almost certainly not present up to 1900, otherwise it would have been recognized and recorded by Prof. T. Johnson[2], who made an intensive study of the marine algæ of Plymouth Sound during 1885–1900. I would, therefore, be grateful for any records of the occurrence of this species on the coasts of Britain, so that its distribution or its rate of migration can be followed.

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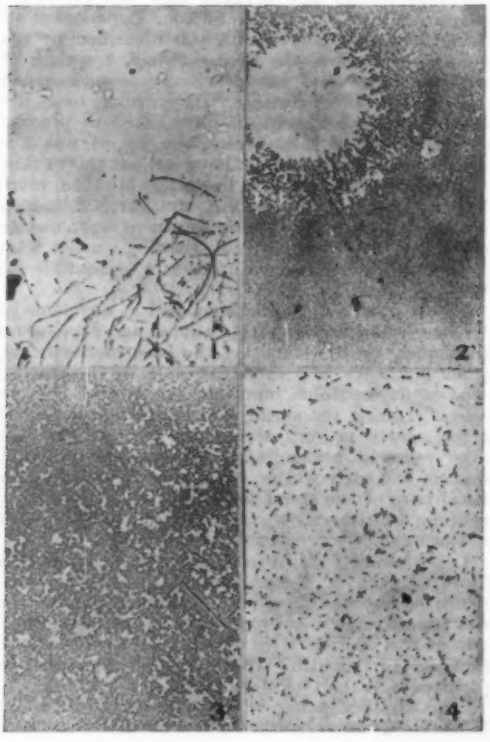
Insecticidal Power and Microscopical Structure of Residual Films of Benzene Hexachloride

IN some recent experiments with samples of the γ-isomer of benzene hexachloride (1,2,3,4,5,6-hexachlorocyclohexane), in which adult beetles of *Dermestes maculatus* Deg. were tested on residual films prepared on glass plates by a recently devised method[1], it was found that in films formed from chloroform solutions, a certain sample of 'technical' grade material (I) was more insecticidal than the corresponding 'refined' sample (II) and 'refined' (III) and 'technical' (IV) samples of different manufacture. These unexpected observations were the reverse of those obtained by other investigators testing the same samples by different methods[2]. Furthermore, when residual films of the insecticides in a light, refined paraffin spray oil were prepared and tested in this laboratory, samples (II) and (III) were at least as toxic as (I).



A microscopical examination of the chloroform films showed that those prepared from sample (I) were different from the others. After a few hours films of (II), (III) and (IV) had crystallized (Figs. 2, 3 and 4), whereas those of (I), prepared at the same time, under the same conditions, had not: the film was present in the form of discrete globules (Fig. 1, upper). These globules crystallized after insects had walked on them (Fig. 1, lower). Unfortunately, because of the high volatility of benzene hexachloride and the resulting short life of the films, it has not so far been possible to obtain crystals in chloroform films of (I) in any other way. Examination of residual films resulting from light paraffin solutions, where crystallization was considerably retarded in every case, showed that films of samples (I) and (IV) were most retarded.

It is of interest to compare these observations with those of Parkin and Green[3], who found, however, that crystallization of globule films of D.D.T. resulted in increased toxicity.

At this juncture no full explanation of my observations can be offered. It seems reasonable to suggest, however, that the unexpectedly high toxicity of sample (I) is not entirely due to an impurity, but may be associated with traces of chloroform retained by the film. The matter is being further investigated.

Thanks are due to Dr. R. A. E. Galley for supplying information, and to the Council of this Research Association for permission to publish.

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Synthesis of *l*-Sparteine

IN view of the synthesis of *dl*-sparteine reported by Leonard and Beylen[1], we wish to place on record that some time ago we effected the reduction of *l*-oxysparteine to *l*-sparteine by treatment with lithium–aluminium hydride. Full details of this work will be published elsewhere in due course.

Since the total synthesis of *dl*-oxysparteine[2], the resolution of *dl*-lupanine[3], the transformation of this and its *d*-component into *dl*- and *l*-sparteine respectively[3,4] and the oxidation of *dl*-sparteine to *dl*-oxysparteine[4] have been accomplished in these laboratories, the structure of *l*-sparteine is now completely established.

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Testicular Hypoplasia and Epididymal Cysts in the Syrian Hamster

We have observed certain definite changes in the testes of some inbred hamsters. These changes are characterized by a striking testicular hypoplasia, mostly bilateral. Such testes, represented sometimes by structures which are almost invisible to the naked eye, appeared very pale, with an apparent lack of normal vascularization. Their individual weight was only 2–306 mgm., as compared with a testicular weight of 0·900–1·400 gm. in the normal hamster. However, we have observed fertile animals the individual testes of which weighed only 0·580 gm. The hamsters with bilateral hypoplasia were, without exception, sterile. On the other hand, the animals with unilateral hypoplasia proved to be fertile. No relationship was found between the hypoplasia and the growth-rate or mature weight of the animals. Although we have also observed hypoplasia of the ovaries and sterility in some females, our data in this respect are inconclusive.

In the epididymi of some inbred and outbred hamsters we have encountered single and multiple cysts, histologically connected with the epididymis itself. Such cysts, of a yellow colour and of a sterile content, varied greatly in size: they varied from the size of a very small pearl to that of a normal hamster testis. In some animals these cysts were found in both epididymi, although most of them were unilateral. Most of the cysts were found in the tail, although a few of them occurred in the head of the epididymis. Most of them contained mainly spermatozoa.

Through the study of the reproductive capacity of hamsters with normal testes but with epididymal cysts, unilateral or bilateral, in some cases making use of surgical ligatures, we observed that the cysts impaired the fertility of the animals only when they were of considerable size, especially when such cysts were located near the beginning of the ductus deferens. This shows that these cysts can produce sterility only by mechanical blocking of the normal passage of the spermatozoa through the epididymis.

In a few cases we have also observed another kind of cyst, the contents of which are devoid of spermatozoa. They are small, yellow formations, usually flattened, round or ovoidal. These cysts are found either free, in the neighbourhood of, or loosely connected to, the tail of the epididymis.

The testicular hypoplasia was observed only in a group of inbred hamsters. They were of different age, 92–240 days, and under different dietary regimes. The epididymal cysts, found in both inbred and outbred animals, were observed mostly in very mature hamsters, 220–240 days of age. The cause of the hypoplasia seems to be of a hereditary nature, similar to that described by Lagerlöf[1,2] and Eriksson[3] in cattle. A complete report with a histological study is being prepared.

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Isophosphorylase

Both pure potato phosphorylase[1] and crystalline muscle phosphorylase[2] produce from glucose-1-phosphate a non-branched polysaccharide containing only α-1,4-glucosidic links and resembling amylose. By the action of extracts of yeast[3], of heart, brain or liver[4], branched polysaccharides are obtained containing up to 10 per cent of α-1,6-glucosidic linkages and resembling glycogen. In 1942, Meyer and Bernfeld[5] reported the presence of an enzyme in yeast which brings about the phosphorolysis of the terminal α-1,6-glucosidic links of residual dextrin (the final degradation product of amylopectin by β-amylase). A purified potato phosphorylase was not able to effect this reaction. It was therefore concluded[6] that there are two different phosphorylases, one of which effects the fission or synthesis of α-1,4-glucosidic links, the other the α-1,6-glucosidic links involved in branching. Cori[6] has found an enzyme in liver extract and also in heart extract which he calls the 'branching factor', and which is able to produce glycogen by simultaneous action with the crystalline muscle phosphorylase. Haworth, Peat and Bourne[7] have described a thermolabile factor which they term the '*Q* enzyme' and to which they attribute the property of synthesizing the α-1,6-glucosidic links in amylopectin. Their '*Q* enzyme' has, in addition, an amylatic action.

We have now succeeded in finding also in potato extract an enzyme which, in the presence of inorganic phosphate, renders residual dextrin accessible to β-amylase attack (see Table 1).

Table 1. Simultaneous action of potato extract and β-amylase on residual dextrin

Addition of potato extract	Degradation by β-amylase	
	Phosphate present	Phosphate absent
Without	0 per cent	0 per cent
With	25 ,,	5 ,,

We have been able to show that, in the presence of phosphate, this same enzyme converts amylose to amylopectin and even to glycogen by simultaneous action with potato phosphorylase (see Table 2). No conversion takes place in the absence of inorganic phosphate.

Table 2. Simultaneous action of potato extract and potato phosphorylase on corn amylose

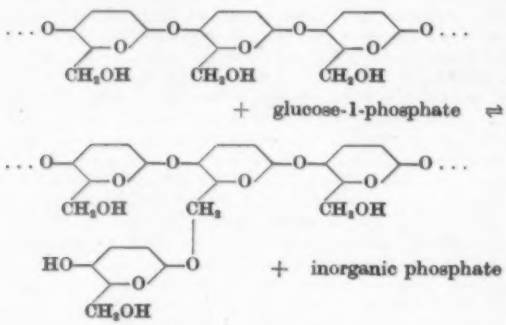
Time in hours	Phosphate present 1·35 P/amylose*		Phosphate absent less than 0·01 P/amylose*	
	Iodine coloration	Conversion limit by β-amylase*	Iodine coloration	Conversion limit by β-amylase*
0	blue		blue	
24	violet		blue	
72	purple		blue	
144	purple	65%	blue	100%

* Mols of phosphate per glucose equivalent of amylose.

The results given in Tables 1 and 2 show that potato extract contains an enzyme capable of catalysing the phosphorolysis of α-1,6-glucosidic links and equally of their synthesis. We propose to call this enzyme 'isophosphorylase'.

Meyer and Bernfeld[5] have shown that potato phosphorylase only brings about the fission of α-1,4-glucosidic links which are proximate to terminal non-reducing groups. This has been confirmed quite

recently by Katz, Hassid and Doudoroff[9]. We have found that isophosphorylase does not attack linkages in the interior of the molecule, and in this respect behaves like phosphorylase, as the viscosity of a starch paste is not reduced in the presence of isophosphorylase. The reversible catalytic effect of isophosphorylase may therefore be schematically represented as follows:



Furthermore, the behaviour of isophosphorylase with regard to the viscosity of starch paste proves the absence of any α-amylatic action in our preparations, which are thus distinct from the '*Q* enzyme' of Peat, Bourne and Barker[7].

We are indebted to Prof. K. H. Meyer for his interest in this investigation.

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Astaxanthin in Insects and Other Terrestrial Arthropods

In a very interesting note on the carotenoids of the locust integument, Goodwin and Srisukh[1] point out the presence of astaxanthin, besides other carotenoids, in *Locusta migratoria* and in *Schistocerca gregaria*. "The demonstration of astaxanthin in locust," they say, "is particularly interesting because, apart from its detection in the retina and eye colourings of birds, this is the first time it has been reported in land animals."

This statement is not quite exact. In 1939 I found this pigment in a mite of the genus *Trombidium*[2]. The pigment is completely extracted by acetone from the mite's body, transferred to petroleum ether and obtained, through evaporation of the solvent, as a red oily residuum (from 3 gm. of mites, 2 gm. of this oil). After saponification, the pigment is taken up again in benzene and after purification by chromatography gives crystals which are intensely violet to red violet under the microscope (2 mgm. of crystals). They give all the reactions characteristic for carotenoids and a peculiar absorption spectrum (a single band at 515 mμ in carbon disulphide and at 500 mμ in pyridine). This result and the chromatographic behaviour and solubility indicate undoubtedly astaxanthin. It is quite probable that this pigment is not infrequent in insects and in other arthropods.

Last year I found a pigment of a similar kind in the potato beetle (*Leptinotarsa decemlineata*). The benzene fraction of the carotenoid pigment gives, with benzene at 70–80°, an orange-yellow zone that splits up in two zones: an epiphasic one, rose-yellow, consisting of β-carotene; an epiphasic one, that is progressing on the column very slowly, eluted with benzene at 70–80° which shows a rose-yellow colour, rose in carbon disulphide, with a spectrum showing one large band with maximum near 497 mμ[3,4]. This pigment looks like the carotenoid pigment that I extracted and crystallized from the fat of a *Phœnicopterus roseus*, the carmin-rose feathers of which perhaps owe their colour to this very pigment. This pigment, which I called 'phœnicoxanthin'[3], shows one adsorption band near 490 mμ in pyridine and differs from astacene both in the position of the adsorption band and in the different solubility and different colour in various solvents.

A full series of investigations is being planned in order to study the metabolism of carotenoid pigments in *Leptinotarsa* fed on various Solanaceæ.

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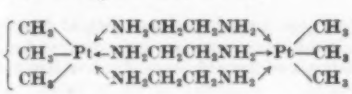
The Trimethylplatinic Group

Pope and Peachey[1] prepared diamminotrimethyl platinic iodide, $(CH_3)_3PtI(NH_3)_2$, readily soluble in alcohol, but sparingly soluble in water. We now find that pyridine added to trimethylplatinic iodide in benzene gives after concentration dipyridinotrimethylplatinic iodide, $(CH_3)_3PtI(C_5H_5N)_2$, m.p. 168°, without previous decomposition, and that similarly from all proportions of dipyridyl and trimethylplatinic iodide, dipyridyltrimethylplatinic iodide, $(CH_3)_3PtI$, dipy, is obtained, insoluble in water, but soluble in chloroform and acetone, m.p. 268–273°. It is apparently unchanged by boiling with dilute acetic acid, hydrochloric acid, ammonia or twice normal sodium hydroxide. It is, however, decomposed by ethylene diamine with formation of sesquiethylenediaminetrimethylplatinic iodide, $2(CH_3)_3PtI.3en$, which may be recrystallized from water. The latter compound can also be prepared from excess of ethylene diamine and trimethylplatinic iodide in benzene.¶ Its structure is probably:



recalling that of iron enneacarbonyl[2]. On refluxing ethylenediamine with excess of trimethylplatinic iodide in benzene, trimethylplatiniemonoethylenediamine iodide, m.p. 204° with decomposition, is obtained. Both ethylenediamine compounds are soluble in water. All four compounds, as also the stable association of trimethylplatinic acetylacetone into double molecules[3,4], are examples of the familiar stability of 6-covalent compounds of quadrivalent platinum.

Less easily classified is the compound obtained from trimethylplatinic acetylacetone or from dipyridyltrimethylplatinic iodide by treatment in benzene with dipyridyl or thallous acetylacetone respectively (m.p. 142–43°, separate and mixed). This compound gives good nitrogen figures for dipyridyltrimethylplatinic acetyl acetone. From a solution of the last-named compound in dilute aqueous acetic acid, dipyridyltrimethylplatinic iodide is precipitated by potassium iodide. The investigation of these and similar compounds is being continued.

The solubilities in water of trimethylplatinic halides, oxide and nitrate[1], closely resemble those of the corresponding silver salts. To use Grimm's expression[5], the trimethylplatinic group is a pseudo-atom of such a nature that other atoms or groups brought into its neighbourhood are frequently subjected to a field similar to that existing in the neighbourhood of a silver atom. We have been unable to find an explanation of this effect.

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Glide Bands in Silver Chloride

As already reported[1], polycrystalline sheets of silver chloride show both sharp and diffuse bands of birefringence after plastic deformation. In addition to this effect, plastic deformation causes fine lines to appear on the surfaces of the sheets; these are similar to the glide lines seen on metallic surfaces which have been polished and then deformed. Examination under the microscope with oblique illumination makes it clear that they are steps. This conclusion is confirmed by using the 'shadow-casting' technique developed in connexion with electron microscopy. Measurements made with an optical microscope of the widths of the shadows cast by the steps show that the heights of the most prominent steps are of the order of 4000 A. It would appear, therefore, that the principal, and perhaps the only, mechanism of plastic deformation in silver chloride is glide. In this respect silver chloride differs from sodium chloride, which at room temperature becomes deformed mainly or entirely by kinking[2,3].

Some grains contain a system of birefringent bands with a series of surface steps running parallel to them. However, bands are frequently seen that are not accompanied by a parallel series of steps and, conversely, most surface lines do not run parallel to a system of bands. The connexion between the bands and the steps has been made clear by the following experiments. Rectangular bars of length 25 mm. and approximately square cross-section (1 mm. × 1 mm.) were recrystallized and large portions were found to consist of chains of single crystals joined up end to end. Plastic extension of these specimens produced the phenomena already observed in the sheets; but the true direction of a given set of glide planes could now be determined by measuring the direction of their traces on two non-parallel surfaces. In this way it was established that, whenever a set of glide planes is observed edgewise, sharp birefringent laminations become visible between crossed nicols. As the direction of observation becomes inclined to the glide plane, the boundaries of the glide packets become less sharp; the stress patterns in different glide packets overlap and their details are obscured.

The explanation of the characteristic appearance of deformed polycrystalline sheets may therefore be summarized as follows:

(*a*) Most of the grains in a severely deformed sheet contain two or more sets of operative glide planes.

(*b*) A set of glide planes produces steps on the surface, provided the direction of glide is not parallel to the line of intersection of glide plane and surface.

(*c*) The lamellæ which lie perpendicular to the surface give sharp birefringent bands; other lamellæ give diffuse bands or irregular patches of birefringence.

(*d*) Occasionally a single grain contains two sets of operative glide planes lying perpendicular to the surface. In such a case intersecting systems of birefringent bands are observed (Fig. 2 in ref. 1).

(*e*) In flat strips, either bent or extended by uniaxial tension, the stress system is such that the glide direction in planes lying perpendicular to the surface will tend to be parallel to the surface (at 45° to the direction of the tension). This explains the frequent occurrence of birefringent band systems not accompanied by surface steps.

Experiments to determine the glide system in silver chloride had an interesting result. The orientations of a number of single grains in both sheets and bars were found by taking X-ray back-reflexion Laue photographs. The crystallographic plane of low indices lying nearest to the observed glide plane was not always the same. Out of six systems of glide bands observed in the bars, four were closest to {111} planes, but in the other two systems the closest plane was a {221}. Out of the eight sets of bands observed in plastically deformed sheets, six were closest to {111} planes and two closest to {112} planes. But in none of these cases was there exact coincidence between crystallographic plane and glide plane; the angle between them had an average value of 4·2°, and in one case was as much as 8·1°. This is far greater than the error of the determination (estimated at ± 1·5°). In spite of its non-crystallographic orientation, however, the glide plane was, in all cases except one, found to contain a [110] direction. This behaviour is reminiscent of that discovered in iron by Taylor and Elam[4] in which only the glide direction, [111], is fixed crystallographically, the glide plane being dependent on the stress distribution.

In the tensile experiments on bars of silver chloride, the [110] direction lying in the glide plane was always that one of the six equivalent [110] directions which lay most nearly at 45° to the direction of the tension, or, if there were two glide systems in the same grain, the two [110] directions nearest to the 45° position were selected. Moreover, the glide plane was never more than 9° away from the plane of maximum resolved shear stress containing this favourable [110] direction. This evidence strongly suggests that at room temperature silver chloride becomes deformed by 'pencil glide'[4] in the [110] direction. In iron crystals, pencil glide is connected with the fact that at room temperature the critical stress for glide is the same on three different crystallographic planes, all containing a common glide direction. It seems that this process has not been observed until now in any other crystals. A pencil glide can easily spread from one grain to its neighbour, and this explains the frequent occurrence in the silver chloride sheets of slip lines continuing across grain boundaries.

In single crystals of silver chloride extended by simple tension, Stepanow[5] found glide on planes within 5° of {110} in a [110] direction. This result is in agreement with the conclusions reached above, for in Stepanow's experiments the crystals happened to be prepared with a {100} plane perpendicular to the axis of tension and, under these special conditions, the glide elements to be expected on the present theory are just those that he reported.

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Thickness and Height of the Sodium Layer Responsible for the Strong Yellow D Line in Twilight

IN a communication in *Nature*[1] in 1940 I gave a short account of results of investigations on "The Atmospheric Layer from which the Yellow Line in Twilight Originates". From a series of spectrograms from the zenith followed by one from near the horizon, the effective screening height (H_s) of the atmosphere and the upper limit (H_u) of the effective sodium layer were determined. Since then, the results of extensive series of observations from Oslo and from the auroral observatory at Trömso have been published[2,3].

All observations give nearly the same value of (H_s) and (H_u). The mean values were found to be $H_s = 49$ km. and $H_u = 110$ km. The results lead to the conclusion that ultra-violet radiation in the region near 2,500 A., strongly absorbed by ozone, is essential for the excitation of the sodium line in twilight.

Photometric measurements of the intensity of the line for successive twilight spectrograms show that as a rule the intensity keeps nearly constant until it suddenly falls to a lower order of magnitude in the course of a short time (Δt), when the shadow produced by the screening layer leaves the upper limit (H_u). If the sodium layer had been evenly effective throughout the whole interval ($H_u - H_s$), the intensity should have decreased gradually during the time it takes for the effective shadow limit to pass from H_s to H_u.

It is therefore legitimate to conclude that the effective sodium layer is restricted to a thin layer, and that the sudden drop of intensity of the *D*-line begins when the shadow reaches the lower limit of this layer.

Using the zenith observations, the thickness (ΔX) of the layer is given by the formula:

$$\Delta X = (R + H_s) \cos\varphi \frac{\sin h}{\cos^3 h} \cos\delta \sin t \, \Delta t,$$

where R is the radius of the earth, and h, δ and t the height, declination and hour angle of the sun. The value of ΔX has been calculated for twenty series of observations taken at Oslo between October 1942 and April 1943.

The values found for ΔX vary between 8·4 km. and 27·6 km., with an average of 16·2 km. The fluctuations are greater than the possible errors and are, no doubt, to a certain extent real. The values indicate a minimum in December and January and maxima in the autumn and spring. A regular annual variation of H_u and H_s has not yet been found. On an average the sodium layer effective in producing the strong *D*-line in twilight seems to cover a height interval from about 90 to 110 km.

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Treatment of Paper with Silicon Esters

DURING an investigation of the possibility of cross-linking nitrocellulose molecules in solution with silicon esters[1,2], some experiments were also made with cellulose itself in the form of filter paper or unsized kraft paper.

The silicon esters used were tetramethyl, tetraethyl and a polymer ethyl ester (boiling range 210–360°). In a first series of experiments, ordinary filter papers (11 cm. diameter) were exposed to vapours of silicon esters at high temperatures and afterwards placed in a funnel, which was then filled with water. Treatment with ethyl ester for 16 hr. at 120° produced a filter paper which was completely impermeable to water for 11 hours. In a second series of measurements the treatment was made with liquid esters instead. Papers which had been immersed in polymer ethyl ester for 4–66 hr. showed a regularly increasing impermeability against water, improving from 1 to 50 hours. Unsized kraft paper gave similar results, whereas experiments with sized paper of different kinds were unsuccessful.

The wet strength of treated unsized kraft paper was three to seven times larger than that of untreated paper. In order to get the treated papers completely wetted, it was necessary to keep them immersed in water for about one week.

It is also possible to carry out the treatment in such a way that no water repellency is observed but a considerable increase in wet strength is obtained. These experiments were made with very thin filter papers known as 'Stilex' (used in the filtration of

milk). Their wet strength is very low. With liquid methyl ester we observed in five different experiments increases in the wet strength compared with untreated paper of 16–19 times.

It was also observed that treated filter papers are very resistant towards alkaline solutions. It is possible to filter 10–45 per cent sodium hydroxide.

The water-repellency effect is probably of the same nature as that observed by treating paper or other materials with silicones[2,4,5]. The increase in wet-strength, on the other hand, is very likely caused by cross-links of silicon atoms formed between the cellulose chains.

Further details will be published elsewhere. I wish to express my thanks to Prof. The Svedberg for his interest in the work. I am also indebted to Dr. Ragnar Winbladh for including this investigation among the research projects of Centralbolaget.

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Electrical Breakdown of Organic Insulation by Electro-chemical Reactions

RECENT work on impregnated cellulosic insulating materials has shown that electrical breakdown under moderate D.C. stress is normally of an electro-chemical nature. Leakage current is conveyed by ions originating from slight dissociation of the insulating material or from traces of impurities such as moisture or organic acids. The ions on discharge at the electrodes are in a chemically highly active (nascent) condition and may attack the insulation. The attack at the cathode is by nascent hydrogen and, with some forms of insulation, this has serious consequences.

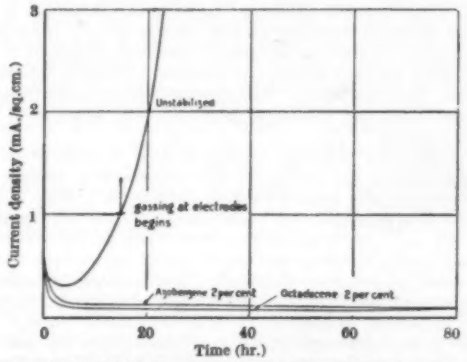
For example, when chlorinated hydrocarbons form part of a dielectric, cathodic reduction leads to release of hydrogen chloride, which itself dissociates in the dielectric, and may result in cumulative increase in current density and chemical attack upon the electrodes or other components of the dielectric.

Egerton and McLean[1] and Berberich and Friedman[2] have shown that the rate of deterioration of capacitors having a dielectric consisting of paper impregnated with a chlorinated hydrocarbon is decreased by the addition of small amounts of the following compounds: quinones, certain nitro-aromatic compounds, maleic anhydride, sulphur, aromatic azo-compounds and benzil. The action of these materials is known as 'stabilization' and has been attributed to formation of a protective film upon the electrodes[1] or a co-ordination complex between the stabilizer and aluminium chloride produced during the deterioration[2]. It is here suggested that a more likely mechanism is that the stabilizer combines preferentially with the cathodically produced hydrogen, without formation of harmful secondary products, thus shielding the dielectric medium from attack.

The experimental evidence in favour of the latter theory is as follows.

(1) All the substances listed as stabilizers are readily capable of reduction, and electrolytic reduction is found to take place under suitable conditions. Thus, we have found that when capacitors which have been stabilized with anthraquinone are opened after use under D.C. stress, under conditions which prevent reoxidation, the reduction product, oxanthranol, is produced. The same substance is found at the cathode on electrolysing acidified alcohol containing anthraquinone. Azobenzene is similarly reduced to hydrazobenzene.

(2) Trichlorbenzene – alcohol mixtures containing a little moisture, when electrolysed at room temperature, increase rapidly in conductivity, with formation of hydrogen chloride, after an initial induction period. Addition of a stabilizer greatly increases the induction period, irrespective of whether aluminium, tin or platinum electrodes are used. Mean conductivity – time curves using platinum electrodes are shown in the accompanying diagram.



Electrolysis of trichlorbenzene – alcohol mixture (50/50 vol. + 2 per cent water) with and without addition of azobenzene or octade ene using platinum electrodes. Stress, 150 volts (D.C.) per cm.

(3) Paper dielectric capacitors impregnated with chlordiphenyl are capable of stabilization, even when made with platinum electrodes. The lives of such capacitors have been extended more than ten times by the addition of azobenzene or octadecene.

(4) Readily hydrogenated aliphatic hydrocarbons, for example, octadecene (see (2) and (3) above), are effective stabilizers. Compounds of this type have not previously been cited as stabilizers and were investigated because of their unsaturated character and ease of hydrogenation.

It can be predicted that any readily reducible compound will stabilize, provided that neither it nor its reduced form appreciably ionizes in solution in the insulating material.

A detailed account of this work will appear elsewhere and further work is in progress.

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Beta Spectrum of Tritium

THE β-spectrum of tritium ($_1H^3$) is of particular interest because: (1) the relatively simple structure of the $_1H^3$ nucleus makes it well suited to a test of the Fermi theory of β-decay; (2) the unusually low energy of the β-particles means that the shape of the spectrum near the upper limit is an extremely sensitive function of the rest mass of the neutrino if the Fermi theory is confirmed; (3) a theoretical discrepancy[1] exists between the half-life[2] and the upper energy limit, as recently measured[3]; (4) the mass difference ($_1H^3 - {}_2He^3$) can be accurately determined.

We have developed a new technique for rapid and accurate detection and energy measurement of β-rays, conversion electrons, γ-rays and X-rays (including *K*-capture radiation) from weak sources. The method, applicable to radiations of energy of 0·5–150 keV., uses a proportional counter, containing an argon – methane mixture at a pressure of one atmosphere or more, connected to a linear amplifier of high gain. The output pulses are applied to the deflecting plates of a cathode ray tube and recorded by a moving-film camera. The size of the pulses is a true relative measure of the energy of the ionizing radiation involved, provided that the range of the ionizing particle within the counter is small compared with its dimensions. The histograms of such pulses show that the resolving power of the apparatus is very good.

Radiation of known energy is used to calibrate the apparatus; for example, the fluorescence radiation of copper has been found to be very suitable. The counting system has been checked over the range 6–50 keV. with radiation from radioactive sources and with X-rays, and very good agreement with known values was obtained. The large Auger effect in argon[4] ensures that practically the whole energy of a photon is converted into the kinetic energy of the photo-electrons which it releases from the gas.

The amplifier gives a measurable pulse about three times the peak noise voltage for a charge of 1,500 electrons at the first grid. Thus, with a gain in the gas of as little as 100—ensuring strict proportionality—a measurable pulse is secured from the formation of 15 ion pairs; the system, therefore, can readily measure electron energies down to 500 eV.

Fig. 1 gives a typical calibration spectrum of the fluorescence X-radiation of copper, showing the *K*α and *K*β groups clearly resolved. The counter contained sufficient tritium gas to give about 5,000 counts per minute, and the X-radiation is superimposed on part of the $_1H^3$ β-spectrum; the distribution shows that a pulse size of 47·5 units (arbitrary scale) corresponds to the *K*α groups of copper, taken[4] as 8·01 keV. Fig. 2 shows the tritium spectrum for the range 1–18 keV. taken under the same conditions. The background, about 15 counts per energy interval, has been subtracted and the energy scale set up according to the above calibration; about 40,000 pulses are analysed. The upper limit is found to be 16·9 ± 0·3 keV., which is considerably higher than a recent estimate[3] of 11 ± 2 keV.

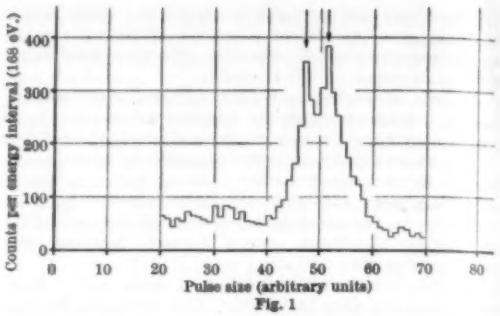

Fig. 1

The calculated Fermi distribution for $_1H^3$ of end-point ~ 17 keV. shows a maximum at about 2 keV.: a maximum appears on our experimental curve near 2·5 keV., but we find that it is definitely rather wider than the maximum of the theoretical curve. We have made various experimental tests which confirm that the shape at low energies is not due to absorption of hydrogen by the wall with consequent loss of range of the emergent electron. The radioactive gas could be pumped off readily and completely, and the shape of the spectrum was found to be independent of the ratio of surface to volume for the counter. Taken with two cylindrical counters of effective lengths 12 cm. and 4·5 cm. and diameters 6·7 cm. and 2 cm. respectively, the results were identical within experimental error. The histograms given here were obtained with the larger tube. The range of the most energetic electrons of $_1H^3$ is negligible compared with the dimensions of this counter. It seems certain that in this work the departure from agreement with Fermi at low energies cannot be ascribed, as in a number of previous spectrographic investigations with other sources, to the ordinary limitations, in particular the thickness and support of the source and the absorption at the window of the detector. This disagreement may be rather important in view of the relative simplicity of the Fermi theory for the light nucleus $_1H^3$.

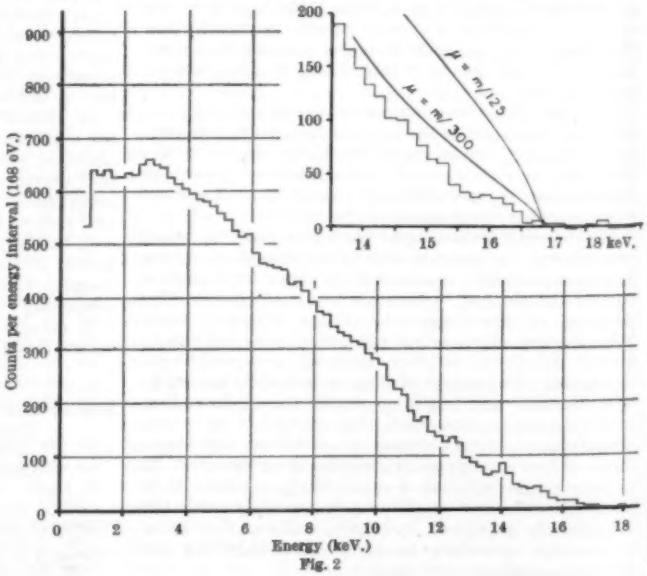

Fig. 2

We have considered the possibility of the spectrum being complex, but its shape seems to rule out such an explanation. The detector is such that γ-rays following emission of β-particles of a hypothetical softer group would have given rise to a readily observable discontinuity on our histograms, since the efficiency of detecting such γ-rays would be ~ 25 per cent. The life-time of the excited state of $_2He^3$ would have to be appreciably greater than the life-time of $_1H^3$ to escape detection.

In view of the above considerations, it is possible to justify the application of neutrino theory to the upper end of the spectrum in the usual manner. However, we have shown in the inset figure two curves calculated for neutrino masses $\mu = m/125$ and $m/300$, and comparison of these with experiment seems to indicate that μ is less than $m/300$.

Since there is no evidence of γ-radiation following the β-emission, we can write the mass equation (atomic) as

$$_1H^3 - {}_2He^3 = 0{\cdot}000018.$$

It is a pleasure to thank Prof. P. I. Dee for his valuable advice throughout the work. We are grateful to Mr B. Touschek for elucidating various theoretical points.

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Velocity of Photons

I am seeking an answer—or a reference to an answer—to an apparent paradox arising out of the theory that light is transmitted in the form of photons, which may be illustrated by the following concrete example.

Atoms of sodium on Sirius, vibrating so as to give out a definite spectral line, send out photons each of which contains the amount of energy ($h\nu$) corresponding to such vibration. These photons, therefore, are identical in all respects, since their energy content is dictated solely by local conditions and clearly cannot be influenced by what may be their ultimate targets, if any. Two such photons are directed towards the solar system, and one arrives at the earth which is approaching Sirius at 30 miles per second, and the other on Mars which happens to be receding from Sirius with the same velocity. What physical factor causes these photons to give different optical effects since (*a*) their internal energies are identical, (*b*) their speeds are also identical, since they arrive at their targets with the velocity (absolute and relative) of light, which is independent of the motions of source and observer ?

I have searched in vain for any explanation of the Doppler effect which recognizes (*a*) that light moves in the form of photons, and (*b*) that the velocity of the photons is independent of that of their source.

Personally, I can see no answer to this query unless the theory as to the travel of light in the form of photons is profoundly modified.

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Latitude Effect and Meson Decay

It has been pointed out recently[1] that the height of the atmospheric layer (100 mb.) in which most mesons are supposed to be produced decreases from the equator towards the poles. The decay of the mesons causes a corresponding increase in cosmic ray intensity.

A first calculation of this effect based on a decay constant[2,3] $L = 5$ km. seemed to indicate that the greater part of, if not all, the latitude effect might be explained thus. A more precise estimation of the 'atmospheric latitude of effect' as distinguished from the geomagnetic can be obtained as follows. The altitude of the 100-mb. level varies not only with geographic latitude but also with the seasons. It is assumed that the seasonal effect of cosmic rays as observed in latitudes where the geomagnetic effect is small, if not nil, is entirely due to these variations. This is called the 'atmospheric seasonal effect'. Further, the 'atmospheric latitude effect' is defined as the variations in cosmic ray intensity caused by the differences at different geographic latitudes in the yearly averages of the heights at which mesons are produced; all measurements having been reduced before to standard atmospheric pressure. The ratio of the two effects can be obtained by comparing the seasonal variation of the meson-producing layer with its average latitudinal variation between the equator and the latitude under consideration. The influence of a differing energy spectrum is neglected.

Measurements with shielded ionization chambers at sea-level[4,5] and tables and graphs of the altitude of the 100-mb. level[6,7] supply all the data required. These are tabulated in columns 1, 2, 3, 4.

1		2	3	4	5	6	7	8
Sydney	34° S.	0·20	2·0	1·3 [4]	1·3	1·5	3·0	13
				1·1 [5]	1·7			
Vancouver	50° N.	0·35	1·2	3·1 [4]	3·1			
				1·2 [5]	1·8	2·5	3·0	14

Column 2: Difference summer–winter of the height of the 100-mb. level in km. (dH).
3: Difference equator–40° lat. of same level divided by value of column 2.
4: Observed difference summer–winter as percentage of cosmic ray intensity.
5: Adjusted column 4.
6: Average of column 5 (dI/I).
7: Atmospheric latitude effect equator–40° lat. as percentage of total cosmic ray intensity, obtained by multiplying columns 6 and 3.
8: Decay constant L in km. obtained by dividing column 2 by column 6.

The values for some of the seasonal variations of cosmic rays have to be adjusted for the difference in the period over which they and the stratosphere data were averaged (column 5). The decay constant L was calculated from the relation $dI/I = -dH/L$, in which I is the cosmic ray intensity and H the height. Taking into consideration the wide differences possible in the measurements of the heights at times as well as localities far removed from the cosmic ray measurements, it is satisfactory to find that the results obtained for the decay constant lie within the range[8,9] of 9–19 km. of the most reliable determinations. In conclusion, it can be stated that the atmospheric latitude effect is about three per cent of the total intensity, that is, one third of the total latitude effect between the equator and the knee at sea-level. This reduction of the geomagnetic latitude effect, if confirmed, will require a revision of the energy spectrum of the primary cosmic rays.

The east–west effect, the nearly constant geomagnetic latitude of the knee, demonstrate also that a great part of the latitude effect is of magnetic origin.

When an attempt was made to obtain accurate corrected values for the geomagnetic effect alone, it was found that the necessary experimental data did not exist. The previously used temperature correction[4,5] presupposes at least a very high correlation between sea-level temperature and the altitude of the 100-mb. level, which is not proved. On the other hand, this correlation could mask a geomagnetic effect extending beyond the knee, the correlation between sea-level temperature and latitude being of the order of 0·9 and more.

The height of the meson-producing layer will depend not only on latitude and season but also on other local meteorological and geographical factors, distribution of land and sea, mountains and so on. To achieve a reliable and accurate correction, it is clearly necessary to obtain simultaneous cosmic ray and high-atmosphere data at the same locality. A new world-wide survey made under these conditions might reveal that some of the unexplained features of Compton's can be explained as a 'local atmospheric effect' and do not represent a variation in primary intensity.

Results obtained during the 1948 cruise of the *Wyatt Earp*, the ship of the Australian Antarctic Expedition, will be published shortly in the *Australian Journal of Scientific Research*. The measurements extend to within 200 miles of the magnetic south pole.

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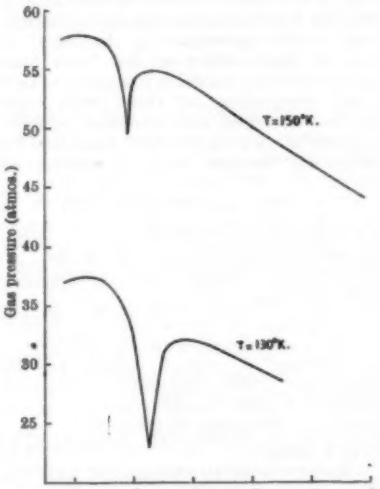
An Approximate Equation of State

In a previous communication which appeared in *Nature*[1], Prof. Max Born and Dr. H. S. Green gave an account of a general kinetic theory of condensed matter (see also refs. 2–5). A new equation of state was derived which covers both phases, liquid and gas. Some numerical results (to be published in detail elsewhere) have now been obtained.

The theory shows that the difference between the liquid and the gas corresponds to the existence or non-existence of real roots of a certain transcendental equation. This was in the original form an integral equation, but has now been reduced, by using a suitable expansion, to an algebraic equation with a unique analytic continuation, so that the definition of the complex roots is unambiguous.

The theory of condensation developed by Mayer[6] and others[7,8] is confirmed by the present theory to the extent that a divergence of the cluster series is found, which is intimately associated with the process of condensation. Concerning the exact point at which this divergence occurs, detailed calculations do not confirm Mayer's contention that it happens at the density of the saturated vapour. The isotherm is continued into the metastable region above this density, rising to a maximum and falling to a subsequent minimum as the density is increased, much in the way foreshadowed by van der Waals more than fifty years ago. The point of divergence is found to be at the minimum of this curve, which separates the metastable states of the liquid from those of the gas.

A numerical computation has been carried out for argon using the Lennard-Jones[9] potential; two isotherms have been calculated, one for the empirical critical temperature ($T = 150°$ K.) and one for a lower one ($T = 130°$ K.). The accompanying graph shows the result.



Concerning the absolute values, one can compare the experimental critical point with the situation of the maximum in the gas region of the first curve. The results are given in the table, for 1 cm.³ of gas at N.T.P.

	Experimental	Calculated
Pressure	50 atmospheres	54 atmospheres
Volume	0·0034 cm.³	0·0052 cm.³

A conspicuous feature of the curves is the fact that for small volumes they do not ascend steeply but have a maximum and fall again. This may be due to the crudeness of the approximation actually employed (namely, only the first three roots of the transcendental equation were taken into account). But it seems to be quite possible that it is an indication of another range of unstable states separating the liquid from the solid. This has to be investigated.

Exact numerical prediction would need a great amount of computation. It seems more important to use the same method for calculating the radial distribution function, which can be compared directly with X-ray experiments. This will be done in a paper in due course.

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ELECTRON OPTICAL OBSERVATIONS ON CHROMOSOME STRUCTURE IN RESTING CELLS

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PRESENT knowledge of chromosome structure is based chiefly on observations made on fixed preparations of large *mitotic* chromosomes or of the so-called giant chromosomes in the salivary gland of certain diptera with microscopes utilizing visible or ultra-violet light[1]. A preliminary account has recently been published of electron microscope studies on large plant chromosomes[2]. Little or nothing is known concerning the structure of chromosomes in *resting* cells beyond the fact that they are present in the form of exceedingly slender threads (chromonemata) or of the so-called chromatin network[3].

Following preliminary observations, made in our laboratory in collaboration with Miss Judith Schryver[4], we have studied in some detail the chromatin structure present in the resting nucleus of calf thymus lymphocytes. An RCA electron microscope of the universal type, equipped with a self-biased electron gun and an objective pole piece corrected for asymmetry[5], was used in this work.

Pure suspensions of thymus lymphocytes were obtained by mincing fresh or frozen tissue under 0·9 per cent sodium chloride solution, straining the resulting milky suspension through gauze, sedimenting the cells in a centrifuge at low speed, and resuspending them in physiological salt solution. The intact lymphocytes have a diameter of approximately 7 μ, while the nuclei measure 5–6 μ. Owing to their relatively large size, the cells as well as the nuclei are opaque when examined directly in the electron microscope. Chromium-shadowed replicas[6] prepared from slowly dried, intact thymus lymphocytes show a *pitted* surface. Its appearance may, to some extent, reflect the underlying structure of these cells, or it may represent an artefact produced by shrinkage upon drying in a high vacuum.

When the lymphocytes are ruptured by quick drying in a special, high-vacuum chamber, or when they are damaged mechanically by placing a suspension of the cells in physiological salt solution in a Waring blendor, a mass of cellular contents escapes through the ruptured cell membrane. After the cytoplasmic components of this mass, which usually remains connected with the 'ghost' of the cell, have been dissolved by washing with physiological saline, the chromatin nature of the residue adhering to the collodium film on the copper screen can be demonstrated with the aid of nuclear stains, for example, acetocarmin or Feulgen stain, and the optical microscope. The examination of the same material, but without fixing or staining it, in the electron microscope reveals a loose mesh of cross-linked fibres of indeterminate length and of varying width, ranging from about 200 A. to 700 A. (Fig. 1). With the exception of dense spots which are situated at cross-over points of the fibres, little, if any, fine structure may be discerned in them. It is believed that the material shown in Fig. 1 represents the *chromatin network* as it exists in the nucleus of resting cells, in agreement with the classical view[3] according to which the 'thread type' nuclei of the cells of glandular tissues consist essentially of a reticulum of chromatin threads distributed in a fluid nucleoplasm. While the nucleoprotein nature of these fibres appears established through their origin, solubility, staining as well as other chemical properties, and their high density towards electron beams, their relationship to or identity with the *chromonemata* or 'resting chromosomes' remains to be determined. The examination in the electron microscope, at low power, of the particles isolated from thymus tissue by repeated use of the Waring blendor at low and high speed according to Mirsky and Ris[7], and designated as 'resting chromosomes' by these workers, indicates that they represent random fragments of the chromatin network resulting from mechanical shearing action rather than preformed units of well-defined structure.

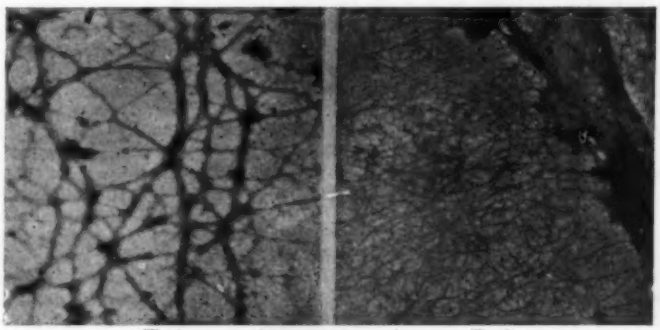


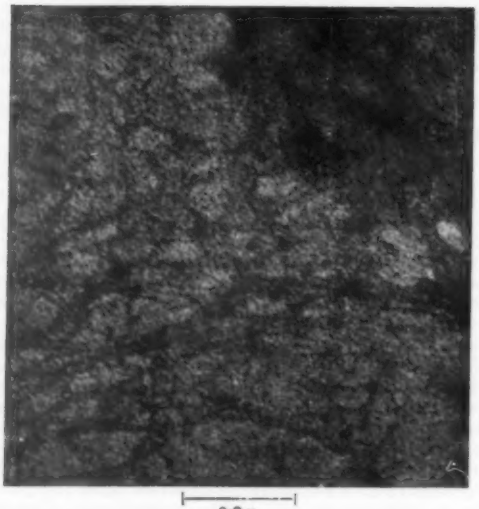
Fig. 1 1 μ Fig. 2

Fig. 1. Chromatin network of thymus lymphocyte, prepared by rupture in high vacuum. Overall magnification, × 20,000

Fig. 2. Ultra-fibrils, obtained by lanthanum acetate treatment of chromatin network of thymus lymphocyte. Overall magnification, × 20,000

Lanthanum salts are known to possess a high affinity for nucleic acid and have previously been used for analytical purposes and ultra-violet microscopy of chromosomes (cf. T. Caspersson[1]). When thymus lymphocytes are treated with lanthanum acetate after the cells have been ruptured mechanically or by exposure to a high vacuum, the fibres composing the chromatin network are further resolved into bundles of fine *ultra-fibrils* of fairly uniform thickness of 80–100 A. (Fig. 2). In addition, the

* Research Fellow, Spanish Cultural Relation Board.
† Weizmann Institute, Rehovoth, Palestine.



0·2 μ

Fig. 3. Photographically enlarged area from Fig. 2, showing fine structure of lanthanum-stained ultra-fibrils. Overall magnification, × 80,000

lanthanum reagent acts as an 'electron stain' on the nucleoprotein ultra-fibrils and permits the detection of details which cannot be seen in unstained preparations. (Structural details of muscle and collagen fibrils have been brought out by electron-staining with phosphotungstic acid by F. O. Schmitt *et al.*) Carefully focused electron micrographs of lanthanum-treated fibrils show that they possess definite fine structure of a high order of regularity. This is evident from Fig. 3, which represents a photographically enlarged area of Fig. 2.

The inspection of a number of electron micrographs of this type suggests that the banded appearance of the lanthanum-stained ultra-fibrils is produced by the *coiling* of a fine thread to form long helices. The apparent width of the individual 'bands' or 'disks' is about 30–40 A., spaced at approximately equal intervals from each other. It is of interest to note that X-ray diffraction measurements on a synthetic albumin thymonucleinate complex[8] and ultracentrifuge and diffusion experiments on thymonucleohistone particles in 0·8 *M* sodium chloride solution[9] have yielded estimates for the width of such molecules of 23 A. and 40 A. respectively. Thus it would appear possible that the structures reproduced in Figs. 2 and 3 represent spirals formed by individual desoxyribonucleoprotein molecules in combination with lanthanum ions. A fine structure of this type has recently been postulated on theoretical grounds by one of us[10].

This work was supported by a grant from the Brooklyn Cancer Committee, the assistance of which is gratefully acknowledged.

[1] Cf. Caspersson, T., *Skand. Arch. Physiol.*, **73**, Suppl. 8 (1936).
[2] Buchholz, J. T., *Science*, **105**, 607 (1947).
[3] Cf. Serra, J. A., *Portug. Acta Biol.*, **2**, 25 (1947).
[4] Schryver, J., M.S. thesis, Polytechnic Inst., Brooklyn (1948).
[5] Hillier, J., and Ramberg, E. G., *J. App. Phys.*, **18**, 48 (1947).
[6] Williams, R. C., and Wyckoff, R. W. G., *J. App. Phys.*, **15**, 712 (1944).
[7] Mirsky, A. E., and Ris, H., *J. Gen. Physiol.*, **31**, 1 (1947).
[8] Astbury, W. T., and Bell, F. O., Cold Spring Harbor Symp., **6**, 109 (1938).
[9] Carter, E. O., *J. Amer. Chem. Soc.*, **63**, 1960 (1941).
[10] Stern, K. G., *Yale J. Biol. and Med.*, **19**, 937 (1947); *Scientia*, **41** (6th Ser.), 74 (1947).

EVOLUTION OF THE DENTITION OF THE ORANG-UTAN

DURING his searches for the remains of the forerunner of man, beginning in 1887 and covering a span of more than twelve years, the late Prof. Eugène Dubois collected prehistoric and fossil teeth of the orang-utan in the islands of Sumatra and Java. Dubois has always been very guarded in his comments on the prehistoric teeth; but the fossil have received much attention because they were ascribed to *Pithecanthropus erectus*. The results of a recent study made by me on this material* are summarized here.

Dubois' explorations started in prehistoric caves in the Padang Highlands, Central Sumatra. The cave fauna appeared to be characterized by the relative abundance of the orang-utan (now confined to the northern parts of the island, and to Borneo), and contained no extinct species. In general, the cave teeth differ from their recent homologues by their greater average size. In several cases I find that the differentiation which the species has undergone since the deposition of their teeth in the caves has proceeded to a stage equal to that of good subspecies.

More than three thousand isolated subfossil teeth of the orang-utan were collected by Dubois in central Sumatra, representing some three to five hundred individuals. The study and statistical analysis of this collection has revealed certain interesting trends in the evolution of the dentition. They stamp the prehistoric orang-utan, which may be known as *Pongo pygmæus palæosumatrensis*, as a larger and more simian form than the recent orang. On the average, the teeth of the prehistoric orang-utan are 16 per cent larger than the recent. The lateral incisors, both in the upper and in the lower jaw, were relatively less reduced in size. The canines were larger and less hypsodont than the recent, and the sexual difference in size was even more pronounced in the prehistoric than it is in the present-day orang-utan. The anterior lower premolar was larger relative to the posterior. The excess in size of the second molar over the first and the third, a typically simian feature that is met with in early stages of the evolution of the hominid dentition, was more pronounced in the prehistoric orang-utan than it is now.

The two upper molars from the middle Pleistocene at Trinil in Java ascribed to *Pithecanthropus erectus* by Dubois have been stated to belong to an orang-utan by Miller, Weidenreich and Von Koenigswald. The careful study of the original specimens leaves no shadow of doubt as to their belonging to the orang-utan. They can be determined as representing M^3 sin. and M^4 dext. respectively, most probably derived from one and the same individual. The fossil Javanese teeth are not larger than their recent homologues.

Pleistocene teeth of the orang-utan have been described from southern China by Pei, Von Koenigswald and Weidenreich. In contradistinction to the Pleistocene teeth from Java, however, the fossil Chinese teeth are decidedly larger than the recent, and they even differ from those of *Pongo pygmæus palæosumatrensis* in their distinctly larger size. A lower canine from the Hoshangtung cave in Yunnan,

* "Prehistoric Teeth of Man and of the Orang-utan from Central Sumatra, with Notes on the Fossil Orang-utan from Java and Southern China." By Dr. D. A. Hooijer. *Zool. Med. Museum, Leyden*, **29**, 175–301, pls. I-IX, 2 diagrams.

China, described by Weidenreich, is made the type of a new subspecies, *Pongo pygmæus weidenreichi*, on account of its being still bigger and less hypsodont than its homologue in *Pongo pygmæus palæosumatrensis*. It has thus become evident that the orang-utans which roamed the Pleistocene forests in southern China and in Java respectively were racially different, the continental form being larger than the Javanese. The fossil canine from Yunnan is structurally ancestral to that of the subfossil Sumatran orang-utan; but the relationship between the fossil Chinese and the subfossil Sumatran race cannot be regarded as firmly established on the base of isolated teeth. At any rate, the Pleistocene forerunner of *Pongo pygmæus palæosumatrensis* must have been larger than that of Java, the island in which the orang-utan is now extinct. The Javanese orang-utan was already of the small size of the present-day Sumatran and Bornean orang-utan in the Pleistocene, and it might very well have decreased in size still further up to the present, a condition that is paralleled by other species in which the record is more complete.

The dental characteristics of the recent orang-utan, which have been used in so many comparative studies on the dental anatomy of man and the apes, have now been shown to be the result of an evolutionary change dating from the emergence of the species early in the Pleistocene. The prehistoric Sumatran and the fossil Chinese orang-utan are still further removed in dental structure from man in the points which distinguish the recent orang-utan dentition from that of modern man. D. A. Hooijer

CARNEGIE TRUST FOR THE UNIVERSITIES OF SCOTLAND

THE forty-sixth annual report of the Carnegie Trust for the Universities of Scotland, Dunfermline, covers the academic year 1946–47 and again includes as appendix the new scheme for the award of fellowships and scholarships which came into effect on October 1, 1947. Grants made under the eighth quinquennial distribution for the period October 1, 1947, to September 30, 1952, and detailed in an appendix, include £33,650 to the University of St. Andrews, £13,350 to University College, Dundee, £70,000 towards the erection of the final portion of the Chemistry Institute at the University of Glasgow, £47,000 towards the cost of the new Chemistry Department at the University of Aberdeen, £23,000 for library expenditure and £25,000 for capital expenditure on the university schemes on the Bush and Dryden estates at Edinburgh, the grand total being £234,000 to the universities and £36,000 to extra-mural colleges. Special attention is directed to the observations in the report on assistance to students. The Executive Committee, examining the new situation created by Circular 106 of the Scottish Education Department, considered that until the amount of the bursary awarded by the education authorities had been ascertained for each individual applicant to the Trust, it would be premature to make any extensive alterations in the system adopted for the award of Carnegie Trust grants. Nevertheless, the Executive Committee expected that a turning point in the administration of the Carnegie Trust, so far as half its annual income is concerned, may have been reached, and that very considerable sums at present absorbed in assistance with class fees will be liberated for new projects. The amount disbursed for this purpose during 1946–47 was £51,072 to 3,068 beneficiaries, as against £55,109 to 3,250 beneficiaries in 1945–46.

In the report on the work of investigators during the year, special reference is made to the work of the following: J. L. Miller, on various aspects of high-voltage engineering; Eric Reid, on the diabetogenic principle of the anterior pituitary body; A. M. Mathieson, on the use of X-rays for the study of the structure of complex sulphur compounds and of anthracene; J. C. Robb's measurement of the rate of addition of atomic hydrogen to an unsaturated hydrocarbon; and N. Grassie, on the thermal degradation of high polymers of the polyvinyl type. N. Grassie has devised a molecular still of very high performance and has thrown much light on the mechanism of depolymerization; R. I. May has made rapid progress in the study of polymerization in the gas phase; and A. McLaren in investigations of the role of radicals in polymerization. Mention is also made of the 'cruciform' macromolecule compounds, obtained by C. W. Youngson, of D. Ellis and G. T. Dickson's results in the study of the molecular structure of colchicine, and of S. C. Reid and R. C. Stuart's work on the chemistry of mandelic acid derivatives. In his work on the Silurian rocks of the Pentland hills, Dr. A. Lamont has made a major contribution to geology. Dr. D. B. McIntyre has completed his work on the north-west part of the Loch Doon Plutonic complex and is now studying granitization phenomena in the Alps. Dr. N. Holgate has investigated the igneous rocks of the Glen Bervie complex, and Mrs. E. M. Knox's research has revealed the presence of several new types of microspores in the coals of the Limestone coal group of both the Fifeshire coalfield and the Central coalfield of Scotland.

The report of the Superintendent of the Laboratory of the Royal College of Physicians refers to Lieut.-Colonel W. F. Harvey's microscopic investigation of his collections of sections of human tumours, Dr. J. C. Lees and T. W. Lees' tests in mice of the tumour growth-inhibiting power of ten representative drugs, Dr. J. C. Lees and W. W. Park's collection of data regarding 120 cases of carcinoma of types usually affecting older patients but occurring at 30 years or less, and Dr. E. K. Dawson's histological investigations. Work under Dr. W. O. Kermack has been directed chiefly to the synthesis of compounds of possible interest as chemotherapeutic agents; Miss B. Cairns has worked on the synthesis of halogenated 1-azanthracenes, such as 9-bromo-2 : 4-dimethyl-1-azanthracene, and Dr. McKail on benzthiazoles containing an amino-group in the benzene ring. Mr. Bryce Douglas extended his research on *p*-phenanthrolines and related compounds to the synthesis of derivatives containing a basic side-chain in the 4-position and a chlorine atom in the 9-position. Dr. R. A. Miller is working on the determination of the conductivity and chloride content of human mother's milk throughout the lactation period both under normal and abnormal conditions, and Col. Glen-Liston and Dr. F. Chisholm's work on leucorrhœa has been completed, as has Dr. R. S. Barclay's work on the course of mortality and fertility in Scotland during the past eighty years.

The appendixes include a list of publications by fellows, scholars and recipients of grants received since September 30, 1946.

FIFTH COMMONWEALTH ENTOMOLOGICAL CONFERENCE

BECAUSE of the War, thirteen years have elapsed since the last Commonwealth Entomological Conference was held in London, and there is no doubt that the recent fifth Conference, which ended on July 29, has been the best attended and one of the most successful of the series. There were forty-two delegates, representing the United Kingdom, Canada, Australia, New Zealand, India, Southern Rhodesia and various Colonial territories, and the open meetings were attended also by large numbers of entomologists from Great Britain and overseas.

The first day was devoted to a discussion on insecticides and their application. This is the first time that this topic has appeared on the agenda of a Commonwealth Entomological Conference, and it was the only one to be given a full day.

The discussion on recent developments in insecticides was opened by Dr. R. A. E. Galley, scientific secretary to the Insecticides Development and Research Committee. He summarized the present knowledge on synthetic insecticides, many of which are still in the early experimental stage. Particular interest lies in the development of systemic insecticides which are absorbed by plants and thereafter toxic to insects which feed on them.

Dr. V. B. Wigglesworth, director of the Unit of Insect Physiology of the Agricultural Research Council, in a discussion on the mode of action of the new insecticides, said that D.D.T. if injected internally was almost equally toxic to insects and vertebrates. The reason that the former are so readily affected if they come in contact with D.D.T.-treated surfaces, while the latter are unharmed, is because of the readiness and rapidity with which absorption takes place through the insect cuticle. An account of Canadian experience with the new insecticides was given by Mr. W. A. Ross, of the Canadian Department of Agriculture, who stated that, of them, D.D.T. was the one most extensively used. Because of the great increase in the importance of orchard mites following the use of D.D.T., a search for efficient acaricides is one of the principal problems of fruit insect research in Canada. Several promising ones have already received preliminary investigation.

A discussion on the application of insecticides from the air was opened by Dr. D. L. Gunn, of the Anti-Locust Research Centre. After mentioning the question of costs, Dr. Gunn spoke of the importance of ensuring a sufficiently homogeneous coverage of the target area. He pointed out that while a great deal of publicity has been given to aircraft spraying, and while in certain circumstances it would undoubtedly prove of value, little is yet known as to whether it can establish itself in competition with other methods.

Dr. W. R. Thompson, of the Commonwealth Bureau of Biological Control, who was to have opened the discussion on the biological control of insects, was unable to be present, and this session was opened by Mr. A. B. Baird, of the Canadian Department of Agriculture. Mr. Baird gave an account of the work of the Bureau of Biological Control since the last Conference, and spoke also of projects, mostly involving forest insect pests, with which he had been associated. Dr. W. Cottier, of New Zealand, followed with an account of the successful biological control of the small cabbage-white butterfly (*Pieris rapæ* L.) in New Zealand, and Dr. R. H. Le Pelley described the steps leading up to the control, by means of introduced parasites, of the coffee mealy bug in Kenya. This insect has at different times passed under different names, and this led to the search for parasites, made in the early stages of the investigation, being misdirected. When it was eventually realized that the injurious mealy bug was an undescribed species, native to the adjoining territory of Uganda, the parasite search became properly directed and was successful.

Some account of the general principles of the biological control of weeds by means of insects was given by Dr. D. Miller, of the Cawthron Institute, New Zealand. He also outlined particulars of some of the weed control projects which have been undertaken in New Zealand. These have been concerned with gorse, *Acæna* sp., and ragwort.

Mr. A. H. Strickland of the West African Research Institute, Tafo, Gold Coast, presented an able summary of special techniques relating to the estimation of insect populations in the field. He is of the opinion that little purpose is served by carrying out insect census work unless a preliminary detailed study has been made of the biology and habits of the species of insects concerned.

The discussion on recent developments in the control of stored products insects was opened by Mr. F. N. Ratcliffe, of the Division of Entomology of the Australian Council for Scientific and Industrial Research. He confined his remarks to wheat insects, and mentioned that the exploitation of D.D.T. and benzene hexachloride against grain insects is at present limited by the prevalent fear of their toxicity to human beings. In conclusion he stressed the importance of scientific men who work in this field having a knowledge of the manipulating conditions of the grain industry.

The subject of tsetse fly research and control was opened by Dr. T. A. M. Nash, and Dr. K. R. S. Morris took a prominent part in the discussion. Dr. Nash indicated the main lines in which research has been conducted; he remarked that each of the seven most important species of *Glossina* has different vegetational and climatic requirements, host preferences, and characteristic behaviour. While many methods of control have seemed promising, they have usually failed to produce complete elimination of the fly, with the result that as soon as control measures are relaxed, the fly density starts to rise.

In a discussion of the need for plant quarantine on a continental basis with special reference to Africa, delegates from various African territories gave particulars of the plant quarantine practice in their areas. The danger that might arise from uncontrolled air transport was emphasized.

Dr. B. P. Uvarov, who opened the discussion on locusts and grasshoppers, said that the outstanding result of the past twenty years of locust investigation is the firm establishment of the principle of outbreak areas, where the initial transformation of the solitary phase into the gregarious phase occurs and the first swarms of a plague-cycle are formed. While of recent years great strides have been made in discovering and applying effective palliatives, these must not be regarded as the end-point of the investigation; a radical solution of the problem must be sought in outbreak prevention, which needs more fundamental research.

Following the discussion on locusts and grasshoppers, the remaining part of the last afternoon was

spent considering the recommendations of a Termite Sub-Committee which had been set up at an early stage of the Conference. These recommendations stressed the urgent need for research work on termites, particularly in the Colonies.

During the course of the Conference, delegates visited Whipsnade, Rothamsted Experimental Station, the Pest Infestation Laboratory of the Department of Scientific and Industrial Research at Slough and the new entomological Field Station of the Imperial College of Science and Technology at Silwood Park. These visits, combined with certain social occasions, served to give delegates that chance of informal discussion which is perhaps the most valuable part of a conference of this nature.

FOSSIL FLORA OF KERGUELEN ISLAND

THE biological interest of Kerguelen Island (latitude 49° S., longitude 69° E.) has been well known to botanists since 1847, when the young Joseph Hooker, as junior surgeon in Ross's famous voyage to the Antarctic in the *Erebus and Terror*, contributed a description[1] of the botany of this island gained as the result of the expedition's first winter in the southern hemisphere (May–July, 1840). The extreme poverty of the flora was its most noticeable feature, only eighteen species of flowering plants having been found by Hooker, and of these only eight covered any considerable expanse of ground. These included the remarkable endemic crucifer, *Pringlea antiscorbutica* (the Kerguelen Island cabbage), and a peculiar umbellifer related to the 'balsam bog' of the Falkland Islands. In comparable latitudes in the northern hemisphere much richer floras were known to occur, the vegetation of Spitsbergen, for example, containing records in 1847 of forty-five species of flowering plants on a comparable area. This, coupled with the isolated position of the island in the middle of the Antarctic Ocean, almost equidistant from South Africa and from Australia, the presence of the endemics and the vegetational affinity with the even more distant Falkland Islands (off Cape Horn), are all problems of lively plant-geographical interest to us as to Hooker. Problems of equal interest are those raised by the very marked changes of climate which have occurred in these now desolate latitudes in fairly recent geological time. Hooker himself was profoundly impressed by seeing not only coal but also fossilized tree trunks of considerable size (one is specifically mentioned by Ross as 7 ft. in circumference), although the existing vegetation cannot boast even a shrub, still less a tree, and this circumstance was certainly one of the more powerful reasons which predisposed him to the immediate acceptance of the idea of evolution when it came.

The fossil woods brought back by the Ross expedition were not further investigated until 1921, when Edwards[2] of the British Museum identified them as coniferous. Shortly after this in 1934 Seward and Conway[3] identified araucarian twigs and cone scales in some macroscopic plant remains brought back by de la Rue in 1931. This material also contained the remains of a moss and some indeterminate fragments of dicotyledonous leaves and ferns.

An additional contribution is now available in the eighth part of vol. 2 (pp. 129–142) of the Reports of the British, Australian and New Zealand Antarctic Research Expedition of 1929–31, published at Adelaide, 1947, under the title of "Plant Microfossils from the Lignites of the Kerguelen Archipelago by Isabel C. Cookson" (price 4*s.* 6*d.*). This is one of the few applications of the pollen analysis technique to fossil floras of the southern hemisphere, and though carried out on very limited material the results add greatly to previous knowledge while holding out considerable hope of more to come.

As was to be expected from Seward and Conway and from Edwards, araucarian pollen predominates. This is, however, not the only gymnosperm present. Five distinguishable species, undoubtedly belonging to the Podocarpaceæ though of less certain generic identity within that family, are listed under the form genera of *Disaccites* (*Podocarpidites*), *Polysaccites* (*Microcachryidites*) and *Disaccites* (*Phyllocladidites*). Angiospermous pollen is also present though more sparingly, five species only being so far recorded, three of which appear to be dicotyledons and two monocotyledons. In contrast there are ten varieties of Pteridophyte spores, probably of ferns, but not identifiable generically. There are likewise two species of ascomycetous fruit body.

While the available information does not yet permit of a generalized palæoecological statement to be made of this most interesting region it seems clear that gymnosperms and ferns predominate in the lignites so far examined, the age of which is on that account thought to be Tertiary. It is greatly to be hoped that this work will be further extended by a systematic study of additional collections and through the whole thickness of the deposits.

[1] Ross, J. C., "A Voyage of Discovery and Research in the Southern and Antarctic Regions during the Years 1839–43" (London, 1847).
[2] Edwards, W. N., *Ann. Bot.*, **35**, 609 (1921).
[3] Seward, A. C., and Conway, V., *Ann. Bot.*, **48**, 715 (1934).

BIOLOGY AND CONTROL OF THE PEA MOTH

THE pea moth, *Laspeyresia nigricana*, Steph., is a widely distributed pest of garden and field peas in Great Britain and central and southern Europe, while in North America it has spread to all main pea-growing areas. In England the most severe losses occur in the pea-producing counties of Lincoln, Essex and Kent. D. W. Wright and Q. A. Geering, of the Horticultural Research Station and School of Agriculture, Cambridge, have published a useful paper on the biology and control of the pea moth (*Bull. Entom. Res.*, **39**, pt. 1, 57; 1948).

It appears that the moths show no special preference for ovipositing on or near the flowers or pods. The larva feeds on the young seeds in the pod and bores a hole through the pod-wall for the purpose of reaching its food. The hole heals over, however, in a few days, leaving a small blister. When fully grown the larva spins a thin, web-like cocoon immediately below the soil surface, wherein pupation takes place. The majority of the moths emerge before the end of July in the following year. Normally there seems to be only a single generation of this insect in Britain.

The trials that were carried out indicate that different varieties of peas differ widely in their

susceptibility to attack. Furthermore, the infestation on the varieties is influenced by the amount of foliage cover that is available, the heaviest attacks being where the cover is most dense. Certain varieties of peas are well known to escape much of the severity of pea moth attack if sown early. Also, it appears that crops can be grown almost free from infestation if sown in the latter half of June or in July, since they will mature after the flight period of the moth.

It is recommended that the residue of crops picked green should be removed immediately and fed to stock, made into manure or ensilaged. This prevents the caterpillars from maturing in the seeds and pupating in the soil. Experiments using D.D.T. as an emulsion, or as a suspension, showed that considerable reduction in attack could be obtained with the concentration at 0·5 per cent by weight of D.D.T. It was found that the spray should be applied before egg-hatching has begun which, for sowings made in late April and in May, would be about 7–10 days after the first flowers appear on the crop.

APPOINTMENTS VACANT

APPLICATIONS are invited for the following appointments on or before the dates mentioned:

ASSISTANT LECTURER (with high mathematical qualifications) IN THE DEPARTMENT OF MATHEMATICS—The Clerk to the Governors, Chelsea Polytechnic, Manresa Road, London, S.W.3 (August 28).

HISTOLOGICAL TECHNICIAN—Prof. A. Durward, Department of Anatomy, Medical School, The University, Leeds 2 (August 30).

PROFESSORS or ASSISTANT PROFESSORS OF PHYSICS, ZOOLOGY, BOTANY, MATHEMATICS, GEOGRAPHY, at the Higher Teachers' Training College, Baghdad; PROFESSOR or ASSISTANT PROFESSOR OF MATHEMATICS, ASSISTANT PROFESSOR OF PHYSICS, PROFESSOR OF BIOLOGY, LECTURER OR ASSISTANT PROFESSOR OF PSYCHOLOGY, PROFESSOR OF CHEMISTRY, at the Queen Alivah College; DEAN, and a PROFESSOR OF ELECTRICAL ENGINEERING, at the College of Engineering; ASSISTANT PROFESSOR OF ECONOMIC STATISTICS, at the College of Commerce—The Cultural Attaché, Iraqi Embassy, 22 Queen's Gate, London, S.W.7 (August 31).

ASSISTANT IN BOTANY—The Secretary, The University, Aberdeen (August 31).

H.M. INSPECTORS OF FACTORIES—The Secretary, Ministry of Labour and National Service (O.E.11), 80 Pall Mall, London, S.W.1 (August 31).

PRINCIPAL, a PROFESSOR OF CIVIL ENGINEERING, a PROFESSOR OF MECHANICAL ENGINEERING, and a PROFESSOR OF ELECTRICAL ENGINEERING, at the Government College of Engineering, Dacca—The High Commissioner for Pakistan, 14 Fitzhardinge Street, London, W.1 (August 31).

SENIOR PROFESSIONAL OFFICER (Ceramic and Refractory Research), University of the Witwatersrand, Johannesburg—The Director, Government Metallurgical Laboratory, c/o Mr. Victor Reid, South Africa House, Trafalgar Square, London, W.C.2 (August 31).

CHEMIST-IN-CHARGE at the Royal Ordnance Factory, Pembrey, under the Ministry of Supply—The Ministry of Labour and National Service, Technical and Scientific Register, K Section, York House, Kingsway, London, W.C.2, quoting F.606/48A (August 31).

CHEMISTS in certain Explosive Factories in the Directorate of Ordnance Factories under the Ministry of Supply—The Ministry of Labour and National Service, Technical and Scientific Register, K Section, York House, Kingsway, London, W.C.2, quoting F.605/48A (August 31).

LABORATORY ASSISTANT (Grade I) IN THE DEPARTMENT OF ZOOLOGY—The Secretary, Bedford College for Women, Regent's Park, London, N.W.1 (September 4).

LECTURER IN AGRICULTURE, a LECTURER IN DAIRYING, an ASSISTANT LECTURER IN BOTANY, a LECTURER IN HORTICULTURE, and a HORTICULTURAL ADVISER AND LECTURER (junior post)—The Secretary, West of Scotland Agricultural College, 6 Blythswood Square, Glasgow, C.2 (September 4).

LECTURER (Grade II or Grade III) IN ELECTRICAL ENGINEERING—The Secretary and Registrar, The University, Bristol (September 4).

LECTURER IN INORGANIC CHEMISTRY—The Registrar, King's College, Newcastle-upon-Tyne (September 11).

SENIOR ORGANIC CHEMIST in the biochemistry section for work on the organic constituents of fruit-bearing plants—The Secretary, East Malling Research Station, East Malling, Maidstone, Kent (September 11).

HEAD OF THE INSTRUMENT DIVISION at the National Institute for Medical Research, Hampstead—The Secretary, Medical Research Council, 38 Old Queen Street, London, S.W.1 (September 11).

ASSISTANT LECTURER, preferably with some experience in Radar research—The Registrar, University College, Hull (September 13).

ASSISTANT LECTURERS (2) IN THE DEPARTMENT OF CIVIL ENGINEERING—The Professor of Civil Engineering, Queen's University, Belfast (September 15).

MULLARD READERSHIP IN ELECTRONICS at the Imperial College of Science and Technology—The Academic Registrar, University of London, Senate House, London, W.C.1 (September 15).

PROFESSOR OF POWER STATIONS in the Mechanical Engineering Department of the Faculty of Engineering, Farouk I University, Alexandria—The Director, Egyptian Education Bureau, 4 Chesterfield Gardens, London, W.1 (September 15).

SENIOR LECTURER IN ELECTRICAL ENGINEERING at the University of Melbourne—The Secretary, Universities Bureau of the British Empire, 6 Park Street, London, W.1 (September 15).

PROFESSOR OF BOTANY at Fouad I University, Cairo—The Director, Egyptian Education Bureau, 4 Chesterfield Gardens, London, W.1 (September 15).

INSPECTORS (Salmon and Freshwater Fisheries) IN THE MINISTRY OF AGRICULTURE AND FISHERIES—The Secretary, Civil Service Commission, 6 Burlington Gardens, London, W.1, quoting No. 2258 (September 16).

SENIOR EXPERIMENTAL OFFICER in an experimental research establishment of the Ministry of Supply, near Salisbury—The Secretary, Civil Service Commission, Scientific Branch, 27 Grosvenor Square, London, W.1, quoting No. 2256 (September 17).

RESEARCH FELLOWSHIP IN THE TURNER DENTAL SCHOOL—The Registrar, The University, Manchester 13 (September 18).

SIMON VISITING PROFESSOR, and SIMON RESEARCH FELLOWSHIPS, for Advanced Study or Research in the Social Sciences—The Registrar, The University, Manchester 13 (September 29).

AGRICULTURAL ECONOMISTS (3, one at each College)—The Secretary, West of Scotland Agricultural College, 6 Blythswood Square, Glasgow, C.2; The Secretary, Edinburgh and East of Scotland College of Agriculture, 13 George Square, Edinburgh 8; The Secretary, North of Scotland College of Agriculture, 41½ Union Street, Aberdeen (September 30).

LECTURER (ungraded) IN VETERINARY PARASITOLOGY—The Registrar, Schools of Tropical Medicine and Veterinary Science, The University, Liverpool (September 30).

ASSISTANT EXAMINERS IN THE PATENT OFFICE under the Board of Trade—The Secretary, Civil Service Commission, 6 Burlington Gardens, London, W.1, quoting No. 45A (September 30).

CHAIR OF MECHANICAL ENGINEERING, a SENIOR LECTURER IN ZOOLOGY, a LECTURER IN ZOOLOGY, and a TECHNICIAN IN THE DEPARTMENT OF ZOOLOGY, at Auckland University College, New Zealand—The Secretary, Universities Bureau of the British Empire, 8 Park Street, London, W.1 (October 1).

READERSHIP IN CIVIL ENGINEERING at King's College—The Academic Registrar, University of London, Senate House, London, W.C.1 (October 1).

CHAIR OF ORGANIC CHEMISTRY at the Imperial College of Science and Technology—The Academic Registrar, University of London, Senate House, London, W.C.1 (October 4).

CURATOR OF THE AUCKLAND ZOOLOGICAL PARK—The Office of the High Commissioner for New Zealand, 415 Strand, London, W.C.2 (Auckland, October 29).

LECTURER IN TROPICAL HYGIENE—The Dean, Liverpool School of Tropical Medicine, Pembroke Place, Liverpool 3, endorsed 'Lectureship in Tropical Hygiene' (October 31).

FELLOWSHIPS and SCHOLARSHIPS for the advancement of Extraction Metallurgy—The Secretary, Nuffield Foundation, 12–13 Mecklenburgh Square, London, W.C.1 (November 1).

DEMONSTRATOR IN ZOOLOGY—The Secretary-Registrar, Wye College, Wye, Kent.

PLANT PHYSIOLOGIST to study the physiology of cocoa, with special reference to water, nutrient and light requirements, and PLANT BREEDERS to undertake the selection and breeding of cocoa types and varieties and progeny trials, at the West African Cocoa Research Institute, Gold Coast—The Director of Recruitment, Colonial Office, Sanctuary Buildings, Great Smith Street, London, S.W.1.

SCIENTIFIC OFFICER to deal with administrative aspects of research—The National Coal Board, Establishments (General) Branch Hobart House, Grosvenor Place, London, S.W.1, quoting TT/68.

GRADUATE (or equivalent) as ASSISTANT IN ENQUIRY LABORATORY dealing with works problems submitted by member firms—The Printing, Packaging and Allied Trades Research Association, Randall Road, Leatherhead, Surrey.

HONOURS GRADUATE for work on engineering applications of fluid mechanics—The British Hydromechanics Research Association, 79 Petty France, London, S.W.1.

LABORATORY ASSISTANT (Grade II) for hygiene and bacteriology department—The Secretary, King's College of Household and Social Science, Campden Hill Road, London, W.8.

SCIENTISTS with research and practical experience in (*a*) COAL MINING (Ref. TT/70), and (*b*) COAL CHEMISTRY, analytical work, metallurgy or coal tar (Ref. TT/71)—The National Coal Board, Establishments (General) Branch, Hobart House, Grosvenor Place, London, S.W.1, quoting appropriate Ref. No.

LECTURER IN MATHEMATICS at the University of Otago, Dunedin—The High Commissioner for New Zealand, 415 Strand, London, W.C.2.

CHEMIST by the East African Industrial Management Board, Nairobi, Kenya—The Crown Agents for the Colonies, 4 Millbank, London, S.W.1, quoting M.N.21789/3E.

LABORATORY TECHNICIAN (male) IN THE DEPARTMENT OF CHEMICAL PATHOLOGY—The Secretary, Medical School, Guy's Hospital, London Bridge, London, S.E.1.

MANAGING CHEMIST to take charge of the Metallurgical Development laboratories in the Department of Atomic Energy at Springfields Factory, Salwick, Preston, a CHEMIST-IN-CHARGE (must have extensive metallurgical knowledge with experience in modern methods of metallurgical investigation), and CHEMISTS to supervise experimental work related to the metallurgical development involved in the production of Atomic Energy—The Staff Section, Ministry of Supply, Department of Atomic Energy, Risley, Warrington, Lancs.

LECTURER IN CIVIL ENGINEERING, and a LECTURER IN MECHANICAL ENGINEERING—The Clerk to the Governing Body, Battersea Polytechnic, Battersea, London, S.W.11.

ASSISTANT DIRECTOR (Metallurgical Development) IN THE DEPARTMENT OF ATOMIC ENERGY, Risley—The Staff Section, Ministry of Supply, Department of Atomic Energy, Risley, Warrington, Lancs.